The Electrical Industry's Weekly Magazine

May 18, 1959

Electrical World

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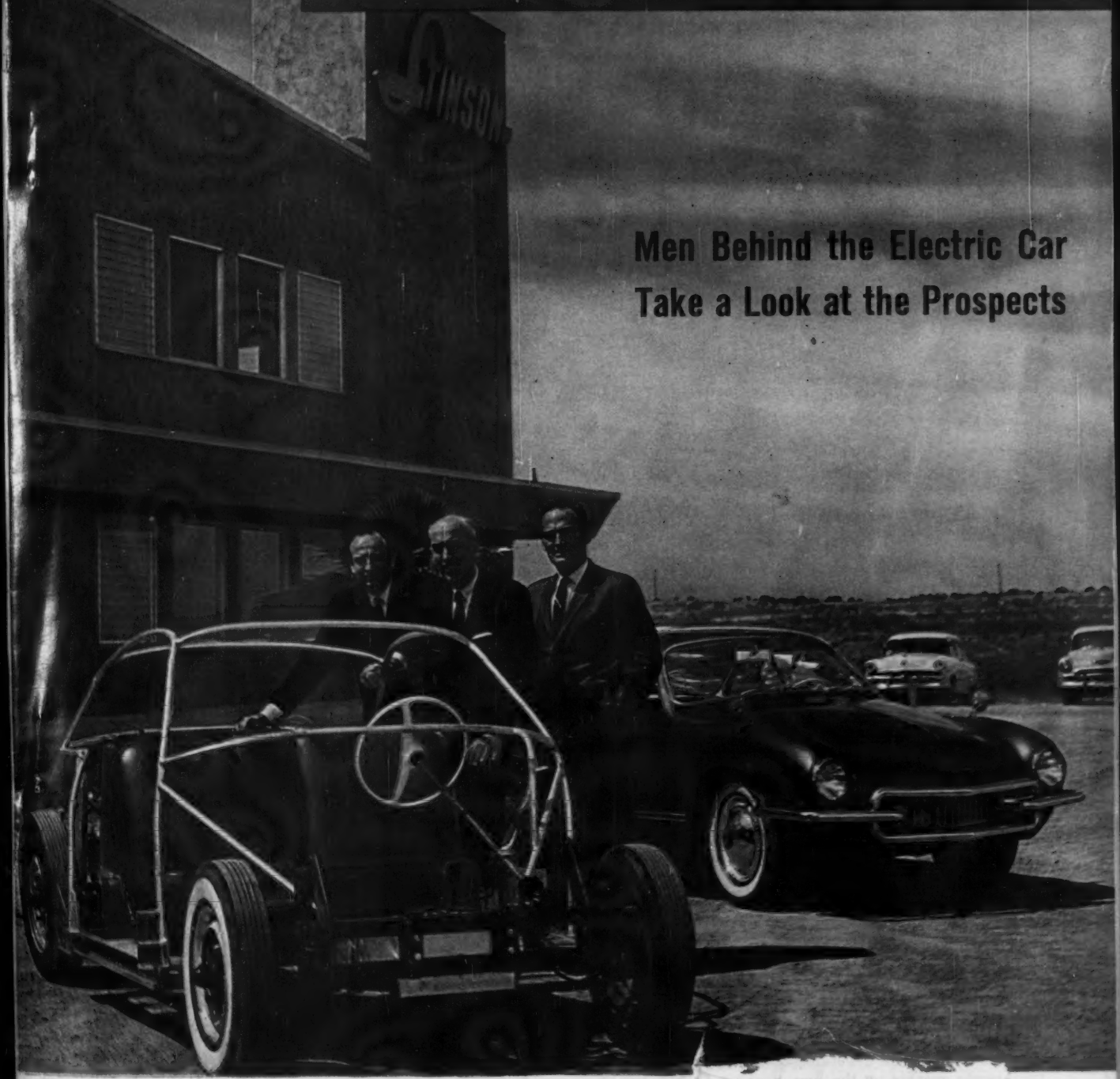
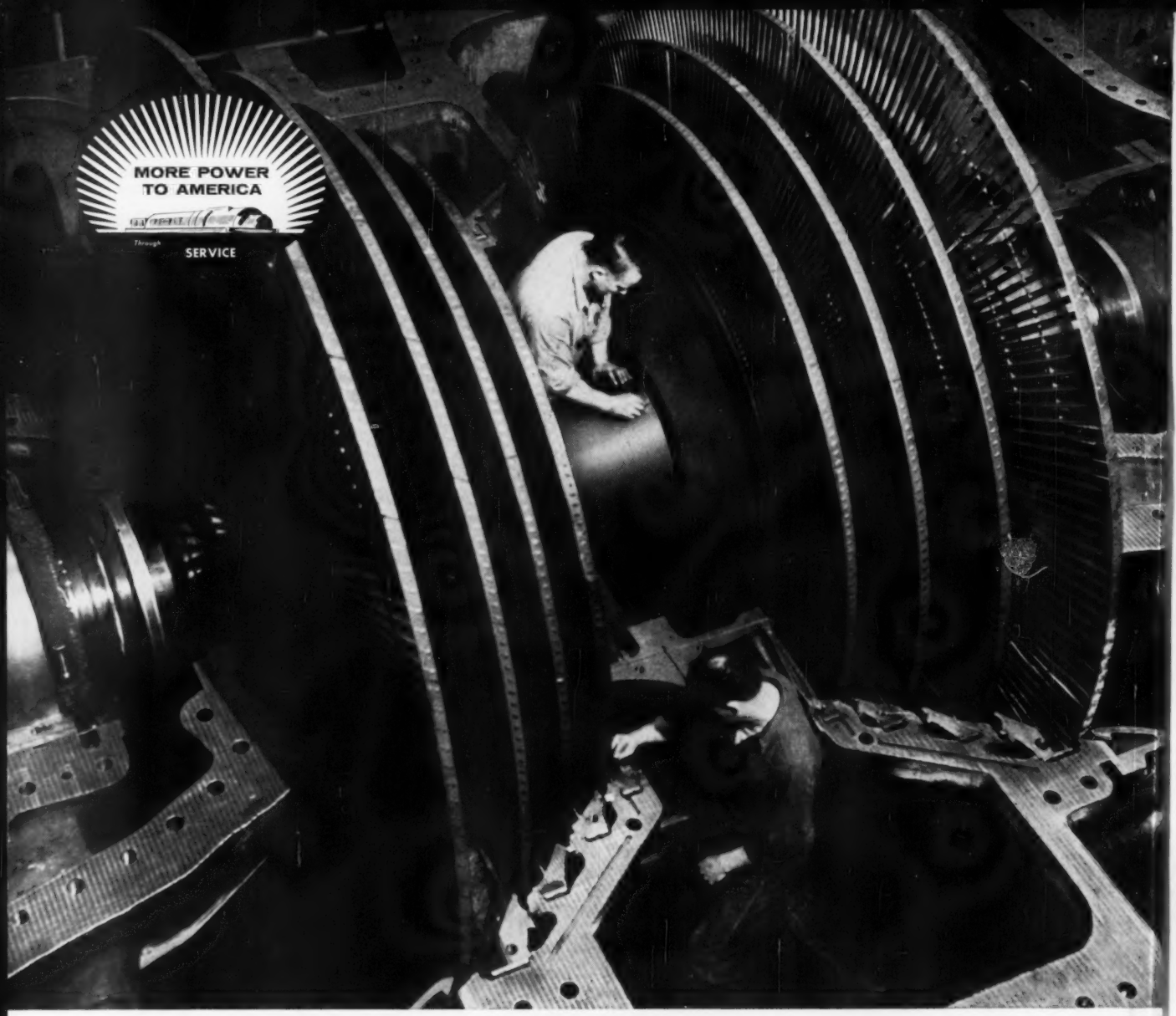


Men Behind the Electric Car Take a Look at the Prospects

The Affluent Co-ops: Have They Outgrown the Need for 2% Money? . . . p 119



Turbine-generator *reliability* is the result of . . .

KNOW-HOW AND SERVICE

Reliability contributes to determining the cost of power generation and the need for system reserve capacity. A unit's reliability becomes increasingly important as larger-capacity turbine-generators are added to a system.

KNOW-HOW—General Electric steam turbine-generators are continually demonstrating the outstanding reliability designed and built into each unit. Engineering and manufacturing know-how and skills at General Electric contribute to this product leadership.

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FACTOR IN NATIONAL SECURITY—Reliable power generation is vital to national security. Recognizing this, General Electric facilities and manpower respond to the needs of electric utilities day in and day out. Whether it be planned or forced outages, natural disaster, international conflict, the General Electric Company is prepared to render prompt, expert service . . . to diagnose, repair or replace power generation equipment.

For more information on these General Electric capabilities, write for Bulletin GED-3666, "Keeping Power Makers on the Line." General Electric Company, Section 301-403, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Electrical World

Vol. 151, No. 20 MAY 18, 1959

Published for 85 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

In This Week's Issue

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COVER—Electric car off the production line is inspected by (l. to r.) Charles Graves of Stinson, Bayard L. (Pat) England of Atlantic City Electric Co, and Deane Van Noy, president of Stinson.

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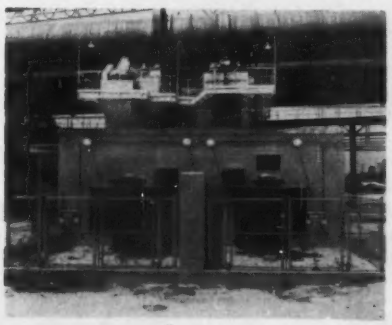

GENERATION

TVA Builds 500-Mw Steam Unit–Largest in U. S.

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Widows Creek No. 7, scheduled for late 1960 completion, will bring plant to 1,250 Mw, 4.5% of system total.....p 70

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Whom Does Congress Represent?

Now the so-called Rural Electrification Administration bill has been defeated by a presidential veto and the failure of Congress to override the veto. But in total, 340 votes in both houses were cast in favor of overriding the veto with 167 against.

Some say that the vote on the bill was mainly a slap at Agriculture Secretary Benson. But it is doubtful if this is the whole story. Whatever else they may have had in mind, the Congressmen were voting to give REA a freer hand to make loans. A soft Administrator could more easily be swayed into supporting the expansion of electric cooperatives into the field of power generation and transmission and into the non-farm business.

But why does such a big majority of Congressmen have such a strong interest in removing a regulatory brake on one group of utilities? Why do they take this position when 80% of their constituents are served by utilities having at least three regulatory agencies and several taxing authorities to supervise their operations?

Whom does Congress represent?

Fischer Black

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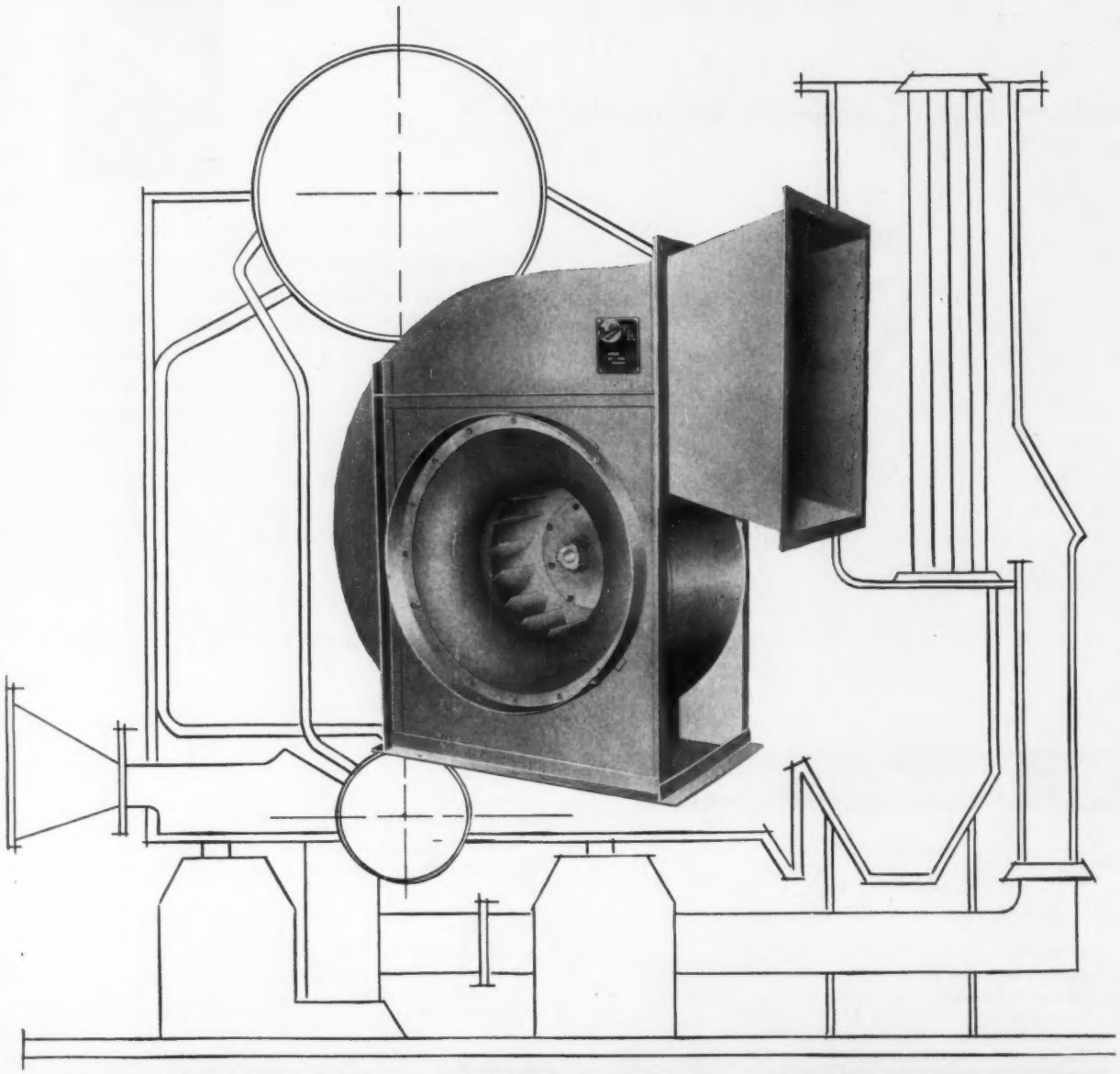

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Combining sharply rising pressure and horsepower characteristics with high static efficiency and resistance to abrasive effects, the "CR" is an ideal fan for stoker-fired or pulverized coal boilers. It is also proving an excellent choice for handling air with dust loadings in a wide range of industrial jobs. Too, these same high-pressure, high-capacity characteristics may mean a smaller fan for many direct-connected applications — a saving in first cost.

Write for Bulletin FD 205 and see the dependable, stable performance built into this husky radial wheel fan for constant volume or inlet-dampered operation. It's one of a *series* of specialized "Buffalo" Draft Fans — including airfoil and backward curve designs with a wide choice of wheels — to give you the best service your operation requires.

NOTE: *Every "Buffalo" Fan has the exclusive "Q" Factor—the built-in Quality which provides trouble-free satisfaction and long life.*

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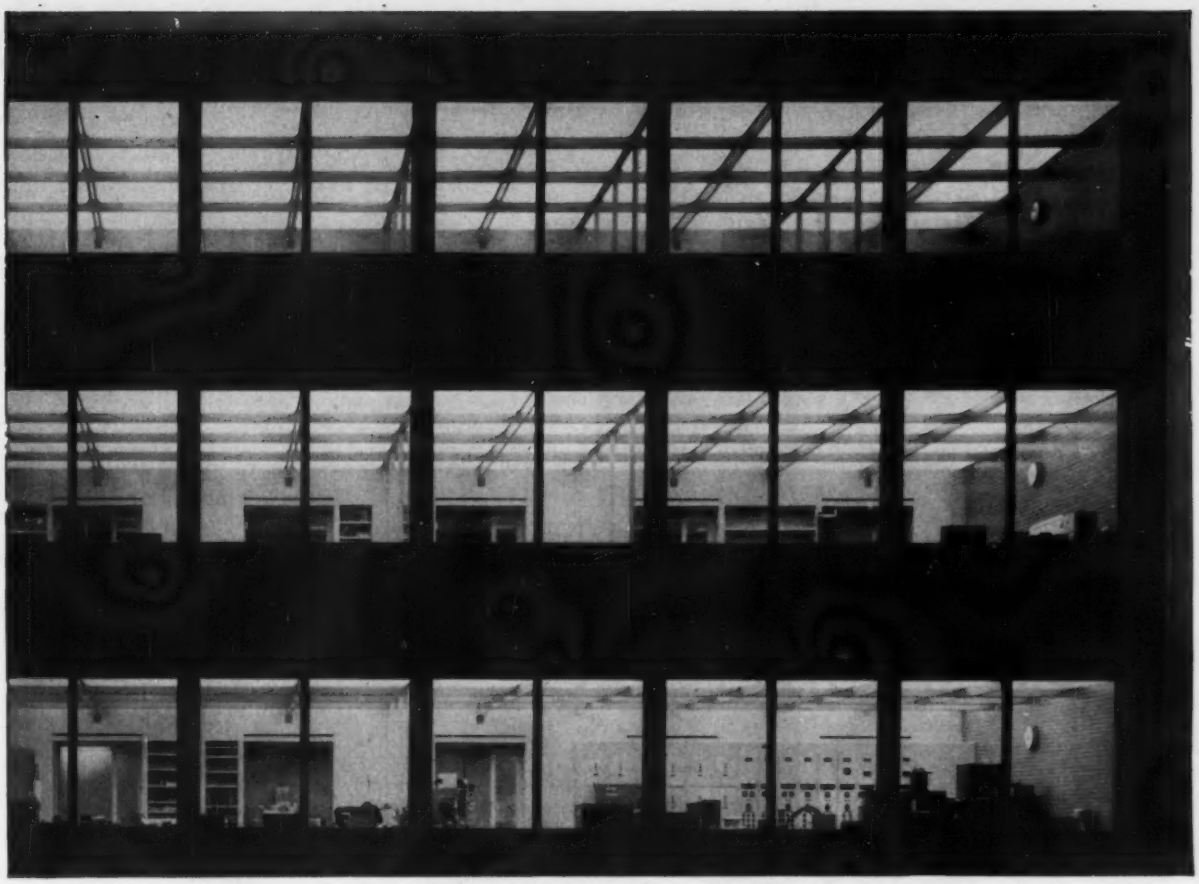

When you are asked to help out with a customer's lighting problem, you'll find us ready and willing to discuss with you the latest ideas, methods and information available from any one source,—Graybar!

For assistance in the selection of equipment for any lighting system . . .

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Every working day brings you questions from architects, electrical contractors, commercial establishments and industrials concerning the right lighting source and equipment to use for some particular installation. Always remember, you can supplement your own broad knowledge and experience through that of our Lighting Specialists,—men who have contributed to the planning of thousands of installations across the country. Graybar's roots are deep in the lighting industry, and ours is a mutual interest – better lighting for all.

Next time you have a knotty lighting problem, call your nearby Graybar office. Back up your dealers and contractors with the best of the current ideas selected from up-to-date developments of the nation's leading equipment manufacturers whom Graybar represents. You'll help build your load through the kind of lighting that will contribute to better production schedules in industry, greater sales for your merchant customers, and greater living enjoyment in homes in your area.

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Change hats
with your maintenance man . . .

You'll find out . . .

Vertical Lift Magne-blast Breakers have low center of gravity, won't tip over

Find a moment soon to ask the man who maintains your metal-clad switchgear which power circuit breakers are easiest to handle.

He'll tell you he prefers General Electric Vertical Lift Magne-blast Breakers because they have a low center of gravity, aren't awkward and difficult to draw out. Vertical lift Breakers are nearly impossible to tip over, reducing the possibility of breaker damage, injury to personnel and disruption of production. General Electric Company, Schenectady 5, New York. 511-33

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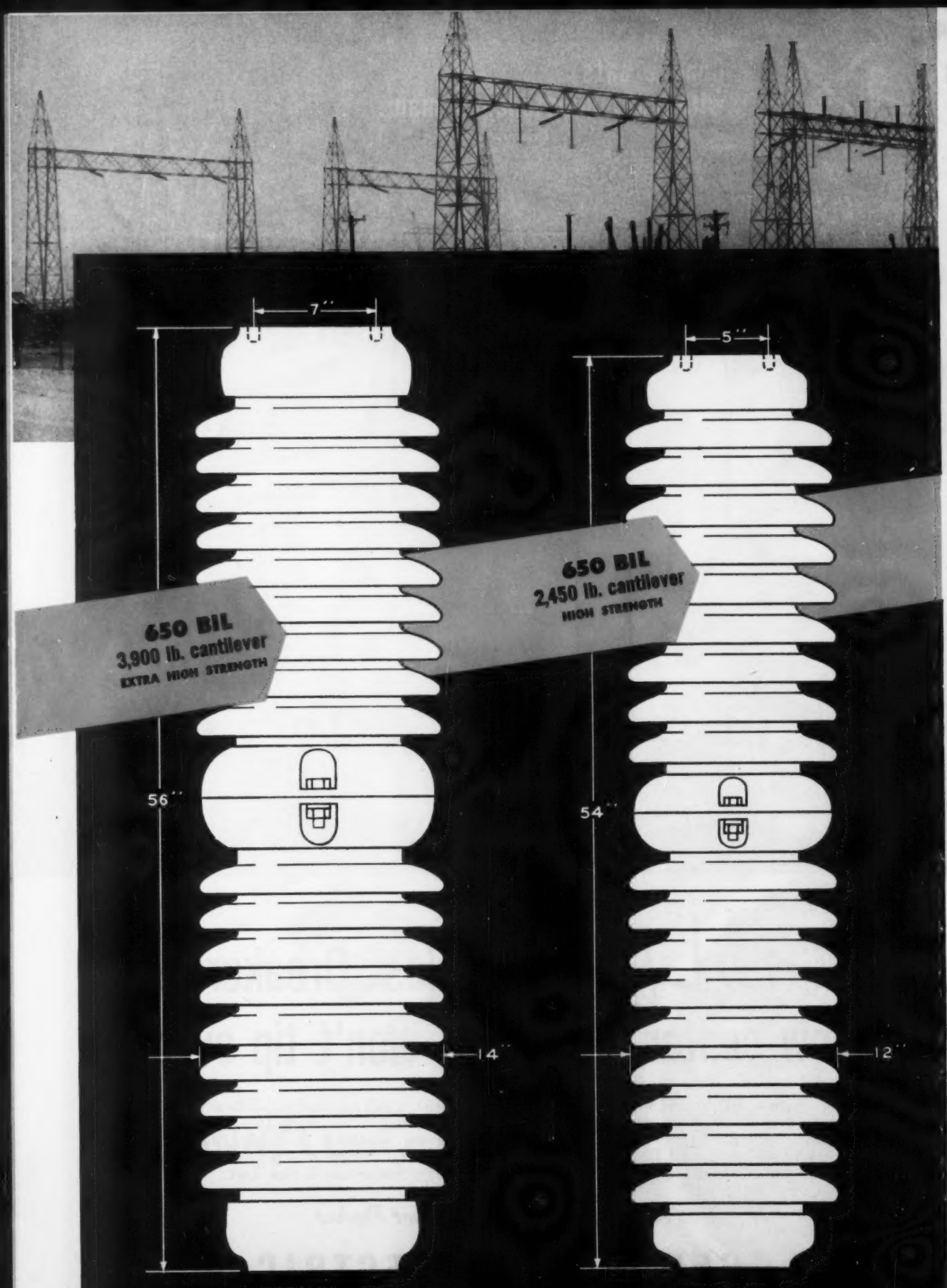
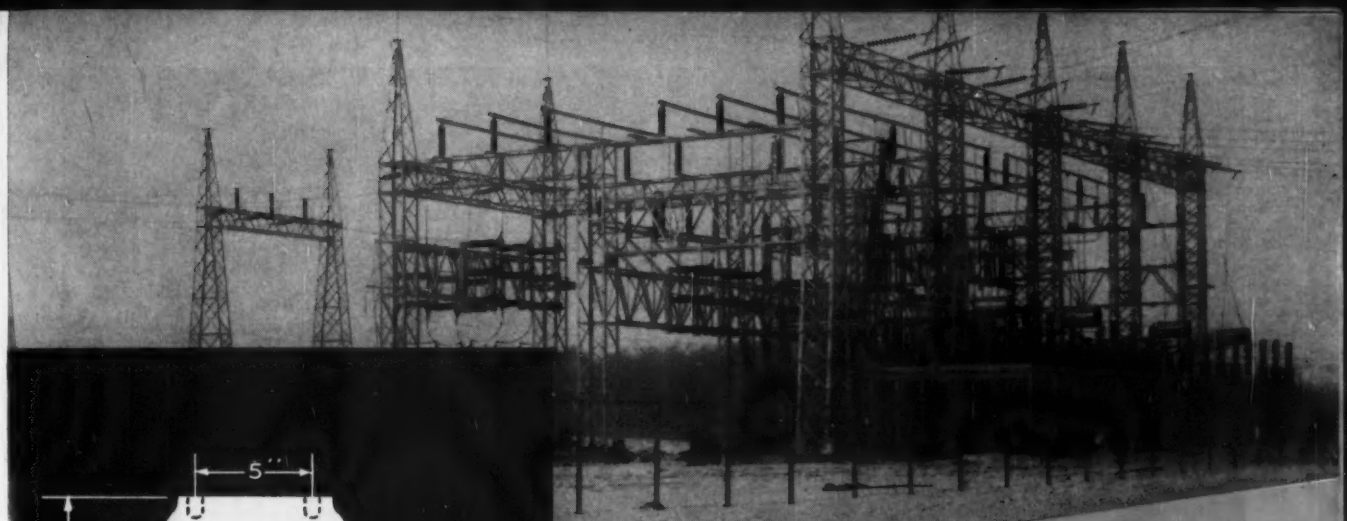
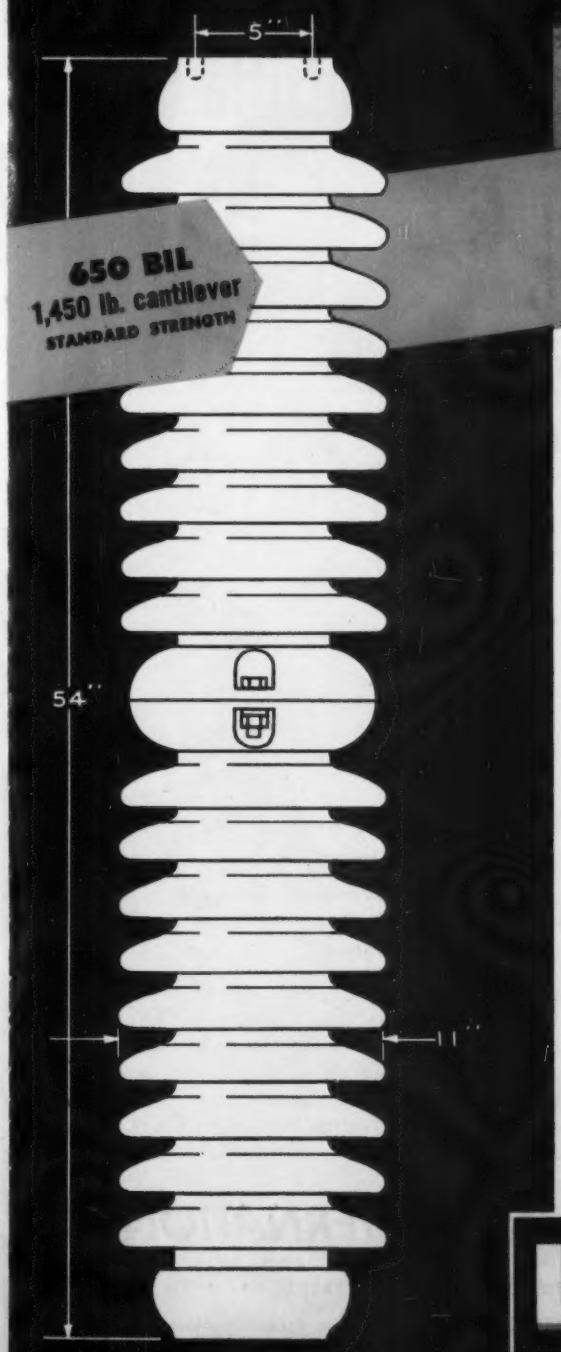
GENERAL ELECTRIC


650 BIL
3,900 lb. cantilever
EXTRA HIGH STRENGTH
650 BIL
2,450 lb. cantilever
HIGH STRENGTH
7"
5"
56"
54"
14"
12"



650 BIL

LAPP STATION POSTS



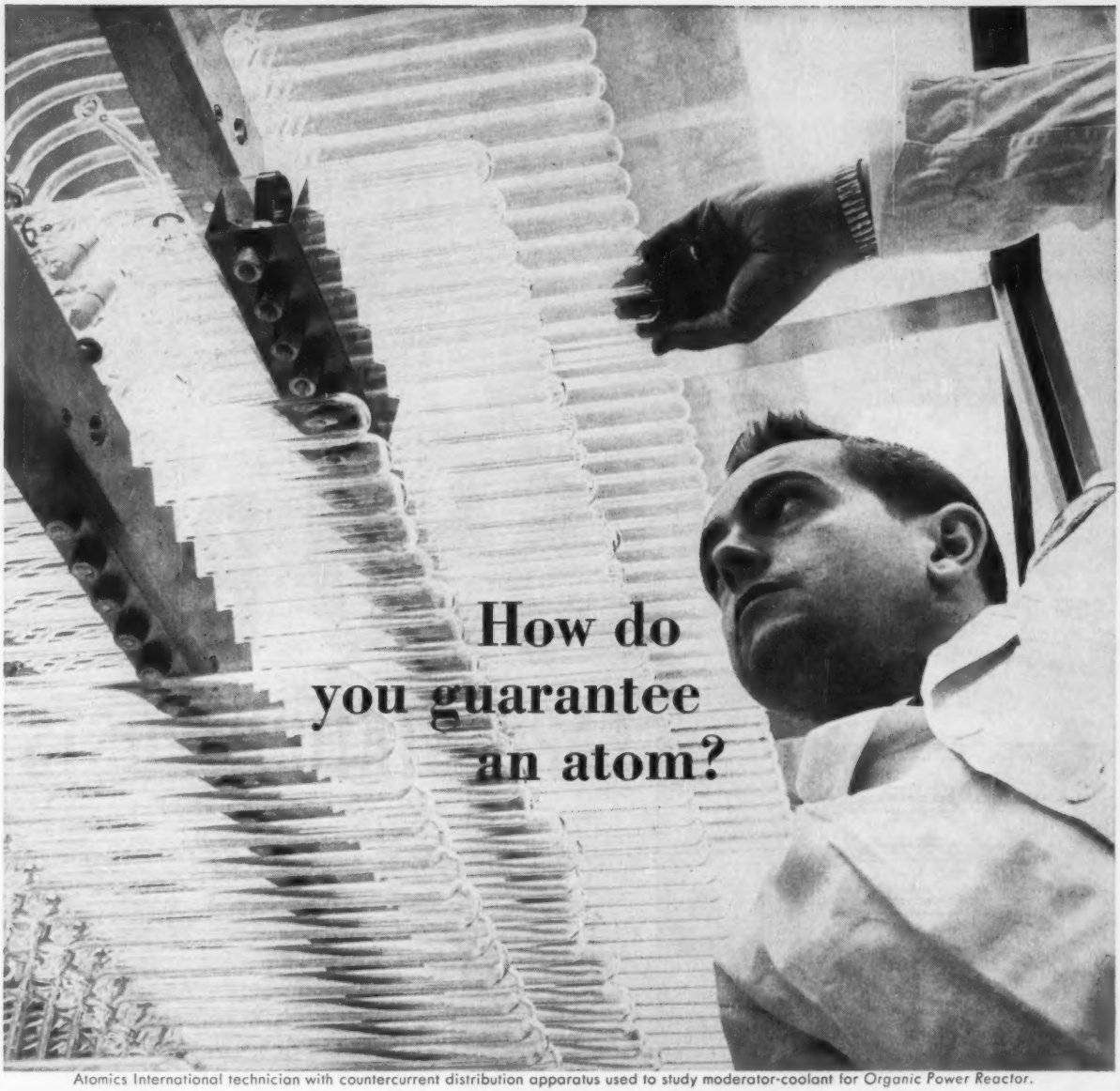
the station insulators specifically designed for 138 kv service

Use of Lapp Station Posts rated at 650 BIL gives designers of 138 kv systems their first chance for most efficient balance of structure cost and electrical characteristics. As compared with use of 161 kv station insulators (until now the only "safe" construction for 138 kv) these new units provide greater strength and rigidity with less weight . . . permit more flexible, more compact station design, with smaller air break switches . . . are suited to horizontal mounting . . . allow wider spacing of bus supports under short circuit forces . . . all at lower costs for insulators *and* structure.

For best performance, highest reliability, lowest cost, design 138 kv stations on Lapp 650 BIL Station Posts.

Lapp Insulator Co., Inc., Le Roy, New York.

Lapp



Atomics International technician with countercurrent distribution apparatus used to study moderator-coolant for *Organic Power Reactor.*

Begin with the knowledge of experienced scientists... conduct a seven-year research and development program ...collect a wealth of solid operating experience. Result: GUARANTEED PERFORMANCE of a nuclear power reactor, designed by Atomics International to help meet the world's power needs.

This is the ORGANIC POWER REACTOR—outgrowth of research and development on the organic system and operation of the Organic Moderated Reactor Experiment (OMRE) conducted by Atomics International for the U.S. Atomic Energy Commission.

Outstanding advantages of the ORGANIC POWER REACTOR: Low capital investment • Low cost operation • High inherent safety and flexibility • Reliability resulting from

• Non-corrosive moderator coolant • Low pressure system
• Conventional, off-the-shelf components and materials
• Easy access during operation

Atomics International is ready to furnish complete ORGANIC REACTOR electric power plants, including fuel elements, in a wide range of power levels. An experienced field staff will assist with initial plant operation, personnel training and maintenance procedures.

For details contact: ATOMICS INTERNATIONAL, Canoga Park, California, U.S.A. Cable address: ATOMICS.

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PIONEERS IN THE CREATIVE USE OF THE ATOM

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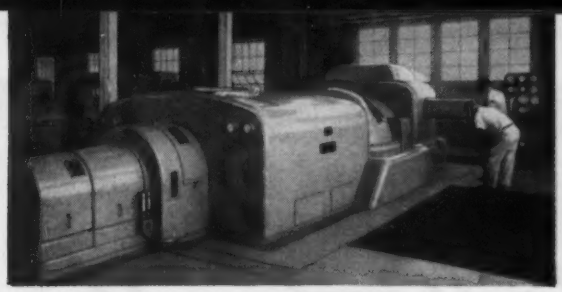
One reason why Fairfield, Illinois has efficient electric service-

Nonpareil Turbine Oil



Plant superintendent James Easton and Standard Oil industrial lubrication specialist Charlie Brown inspect 5,000 kw. Worthington turbine, one of four turbines in Fairfield Municipal Light & Power Company plant lubricated with NONPAREIL Turbine Oil.

These turbine installations trace the record of growth in electric power consumption in Fairfield, Illinois, over the past 19 years:

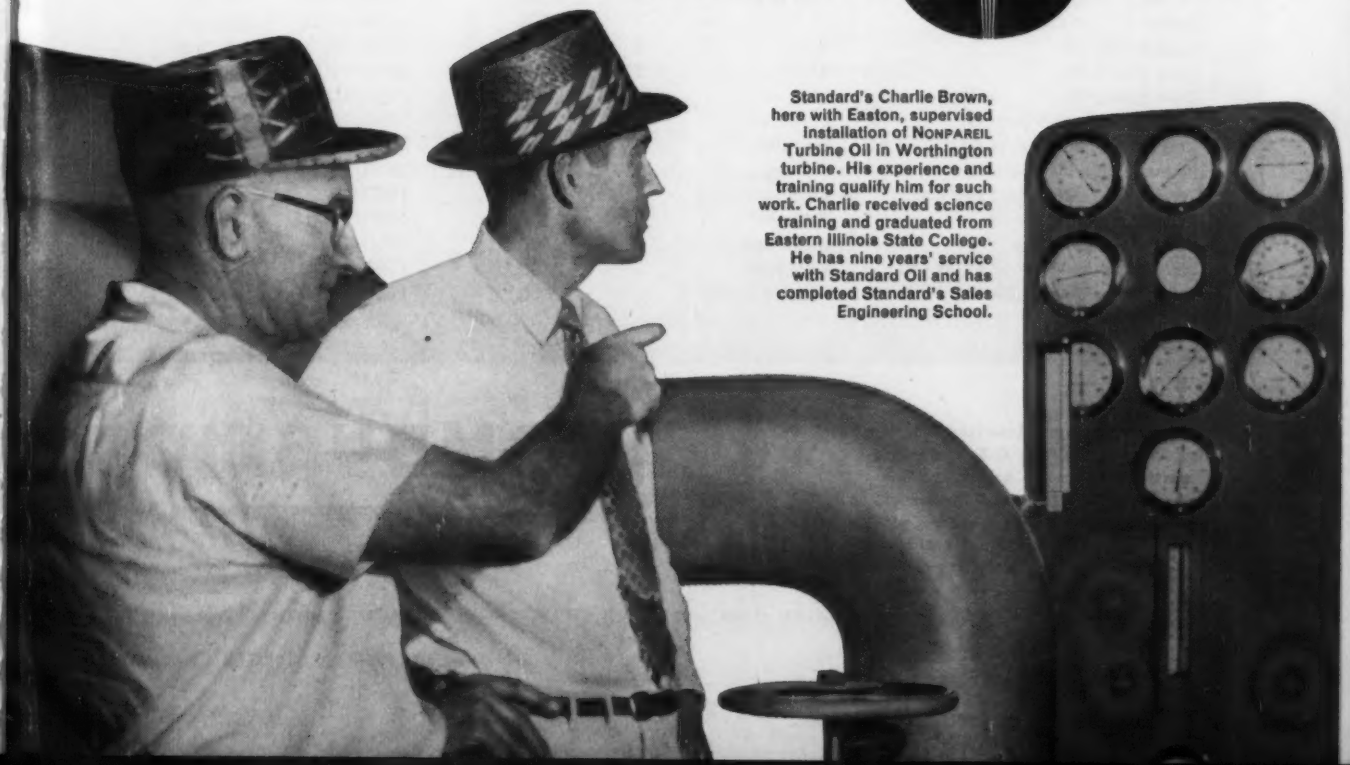
Type	Turbine Cap.	Installed
Westinghouse	1,500 kw.	March, 1940
Westinghouse	2,500 kw.	March, 1942
Westinghouse	4,000 kw.	March, 1949
Worthington	5,000 kw.	July, 1957

When the first turbine went into service, Fairfield Power plant management decided upon a turbine lubricant they felt would be dependable—NONPAREIL Turbine Oil. Standard Oil, they found, would give them concrete evidence of the oil's dependability. They received a certificate guaranteeing that, for the life of the turbine, the acidity of the oil would never exceed 0.15 mg. KOH/g. Indeed, through the years the oil has remained at a much lower acidity level, usually in the order of 0.06 mg. KOH/g. Periodic analysis of the oil in Standard's Whiting laboratory confirms that the oil is performing according to guarantee.

The kind of service Fairfield Municipal Light & Power gets from NONPAREIL Turbine Oil comes about this way: NONPAREIL is the subject of special refining techniques and handling. A special crude is used as a base stock. All sludge-forming compounds are removed. An oxidation inhibitor which permanently controls acidity is added. No sweetening or resting of NONPAREIL Turbine Oil is required at any time.

Men with experience in turbine lubrication can give you more facts about NONPAREIL Turbine Oil. Call your nearby Standard Oil office in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

You expect more from **STANDARD** *and you get it!*



Standard's Charlie Brown, here with Easton, supervised installation of NONPAREIL Turbine Oil in Worthington turbine. His experience and training qualify him for such work. Charlie received science training and graduated from Eastern Illinois State College. He has nine years' service with Standard Oil and has completed Standard's Sales Engineering School.

What's the latest in

C-E BOILERS* FOR HIGHEST STEAM PRESSURES

COMPANY	STATION	No. of Units	Throttle Pressure	Steam Temperature	Capacity—kw Total
		FOR SUPERCRITICAL PRESSURES			
Philadelphia Electric Co.	Eddystone	1	5000	1200/1050/1050	325,000
Philadelphia Electric Co.	Eddystone	1	3500	1050/1050/1050	325,000
Cleveland Electric Illuminating Co.	Avon	1	3500	1100/1050	215,000
		FOR SUBCRITICAL PRESSURES — ABOVE 2400-LB			
Metropolitan Edison Co.	Portland	1	2520	1050/1050	165,000
Metropolitan Edison Co.	Portland	1	2520	1050/1000	225,000
New England Power Co.	Brayton	1	2520	1000/1000	250,000
Virginia Electric & Power Co.	Chesterfield	1	2520	1000/1000	167,000
Virginia Electric & Power Co.	Possum Point	1	2520	1000/1000	225,000
Dayton Power & Light Co.	Tait	2	2490	1050/1000	260,000
		FOR SUBCRITICAL PRESSURE — 2400-LB			
Central Hudson Gas & Electric Co.	Danskammer	1	2400	1050/1000	125,000
Cincinnati Gas & Electric Co.	Beckjord	1	2400	1050/1000	156,250
Cincinnati Gas & Electric Co.	Miami Fort	1	2400	1050/1000	156,250
Cleveland Electric Illuminating Co.	Ashtabula	1	2400	1050/1050	225,000
Cleveland Electric Illuminating Co.	Eastlake	1	2400	1050/1050	187,500
Consumers Power Co.	Karn	1	2400	1050/1050	250,000
Consumers Power Co.	Port Sheldon	1	2400	1050/1000	250,000
Detroit Edison Co.	St. Clair	1	2400	1050/1000	325,000
Duke Power Co.	Allen	2	2400	1050/1000	330,000
Duke Power Co.	Allen	3	2400	1050/1000	825,000
Duke Power Co.	Lee	1	2400	1050/1000	165,000
Niagara Mohawk Power Co.	Dunkirk	2	2400	1050/1000	400,000
Niagara Mohawk Power Co.	Huntley	2	2400	1050/1000	400,000
Pennsylvania Electric Co.	Shawville	2	2400	1050/1000	330,000
Pennsylvania Power & Light Co.	Brunner Island	1	2400	1000/1000	300,000
Philadelphia Electric Co.	Schuylkill	1	2400	1050/1000	175,000
Potomac Electric Co.	Dickerson	2	2400	1050/1000	350,000
South Carolina Electric & Gas Co.	McMeekin	3	2400	1050/1000	375,000
Tennessee Valley Authority	Widows Creek	1	2400	1050/1000	500,000

* The above list covers American utilities only. Abroad, too, the C-E Controlled Circulation Boiler has achieved a predominant position for 2400-lb applications, evidenced by orders placed with C-E or its licensees for 23 units with an aggregate capacity of 5,030,750 kw.

COMBUSTION

Combustion Engineering Building

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

Steam Pressures?

Although one unit for supercritical pressure is presently in service and others are under construction, today's pressure plateau is in the 2400-2520 psi range.

It appears inevitable that many new units will be purchased for this pressure cycle, since it offers a heat rate gain of about 185 Btu over the 1800-psi pressure group. With ever-increasing fuel prices, there is ample incentive to move into this pressure range.

In the entire area of high pressures, temperatures and capacities, Combustion is playing a leading role. As indicated by the list on the opposite page, 38 C-E units have been purchased for use in the 2400-lb pressure range and above – 32 of the Controlled Circulation design. The turbine-generator capacity for the 38 units listed totals about 8-million kilowatts. Already, 14 of these units are in service supplying steam to produce more than 2-million kw. One has been in service over 3 years.

Later this year, a C-E Sulzer Monotube unit, designed for the highest steam pressure and temperature ever employed (5000 psi at 1200 F), will go into service at Eddystone Station of Philadelphia Electric Company. Two more supercritical pressure units, for 3500 psi, are presently under construction. Other similar units for subcritical pressures are already in service for Metropolitan Edison Company and Dayton Power & Light Co.

Along with higher pressure, the trend is toward higher unit capacities. In another year, the average size of high pressure units purchased should be up to 250 megawatts as compared to an average of 200 mw, for the units listed on the opposite page.

ENGINEERING

200 Madison Avenue, New York 16, N. Y.

C-218

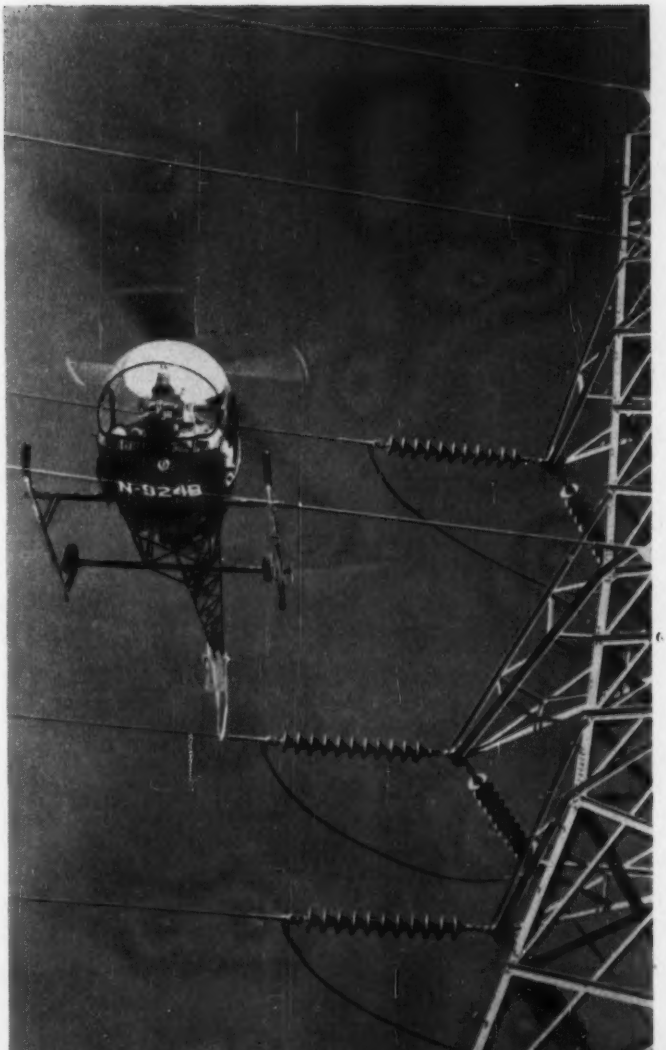
PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

How much could a Bell Helicopter save your company?

Simple problem in arithmetic: you have 440 line-miles to patrol and it takes two men *37 man-days* to make a ground patrol. Aerial patrol by Bell helicopter takes *14 flight hours* for the same job. How much does the Bell save in money, men and time? One utility company, with this exact problem, found the answer to be: $200 saved on every patrol; two trained linemen released for other duties almost 100% of the time; hundreds of hours saved.

There are countless jobs a Bell can do — construction men, oil operators, manufacturers — businessmen in many categories are finding this out every day. How about you? Would a savings in time and expense be welcome to your company? Then let us tell you more about the Bell — explain the three convenient ways you can use it — by Charter Service, Bell's own Lease/Purchase Plan, or Outright Purchase. Write Dept.36-E, Bell Helicopter Corp., Fort Worth, Texas.

Watch "WHIRLYBIRDS" on TV . . .
consult your local paper for time and station

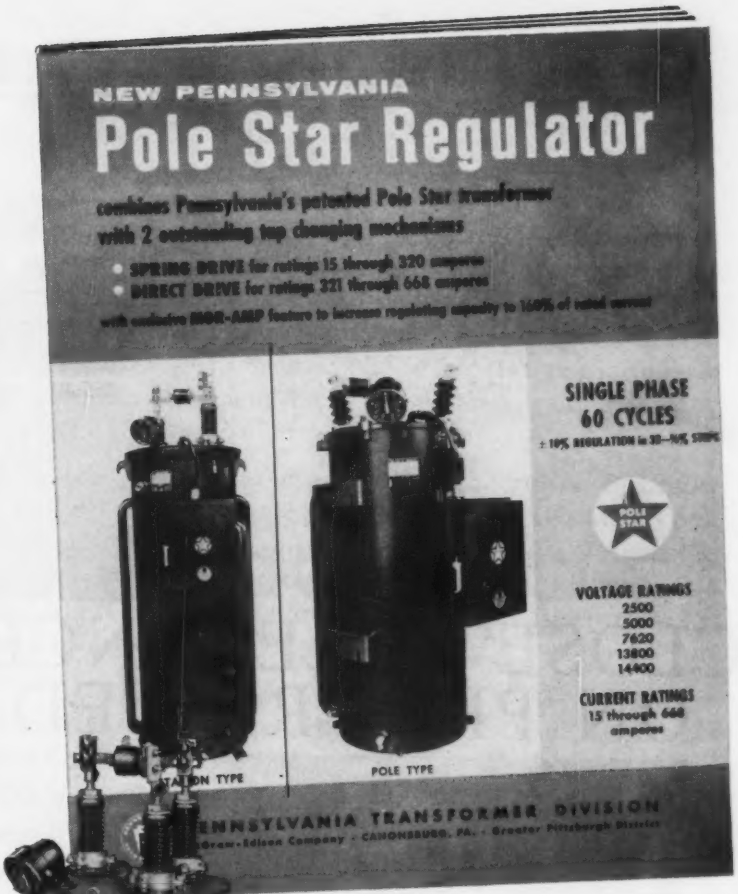


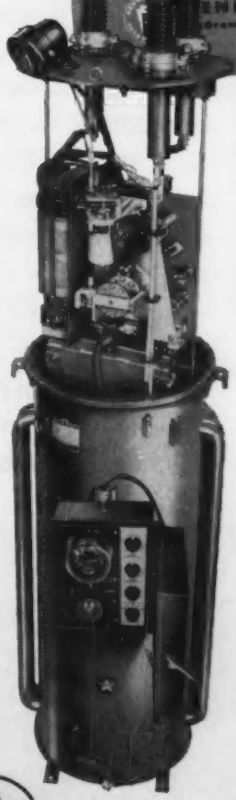
Subsidiary of Bell Aircraft Corporation

BELL Helicopter CORPORATION

Fort Worth, Texas

Pennsylvania introduces a DISTRIBUTION REGULATOR WITH a service-proved POWER TRANSFORMER TAP CHANGER





Single-phase Pole Star Regulator features direct-drive load tap changer

Although new in itself, the Pole Star Regulator is a product of Pennsylvania Transformer's long-term experience in two related fields: distribution transformers and power transformer load tap changers.

As a result, the Pole Star Regulator is introduced with a direct-drive tap changing mechanism that incorporates many of the service-proved principles of Pennsylvania's power transformer load tap changers. Positive mechanical interlocking is assured by direct drive of contacts by means of a scroll cam and index plates. Flat-velocity switch speed reduces arcing and prevents corrosion.

From its distribution transformer line, Pennsylvania has adapted the well-known Pole Star core-and-coil assembly. Included is the patented lap-on-top core, which is unexcelled for low exciting current, low core loss, and uniform quality.

Write for This Bulletin

Bulletin PSR-951 gives details of the 32-step Pole Star Regulator—available in 27 single-phase distribution sizes. For a free copy, use the coupon below, or write on your company letterhead.

NAME_____

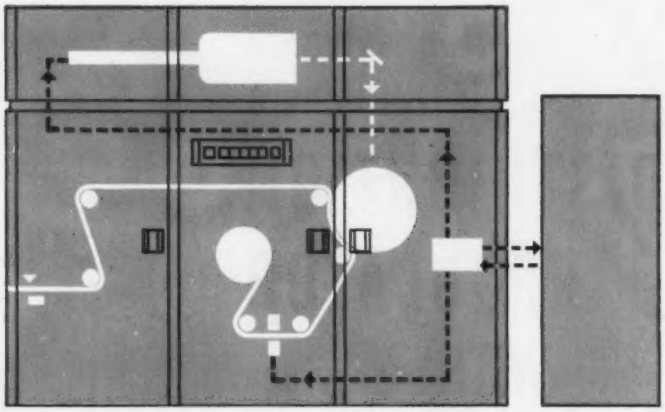
COMPANY_____

ADDRESS_____

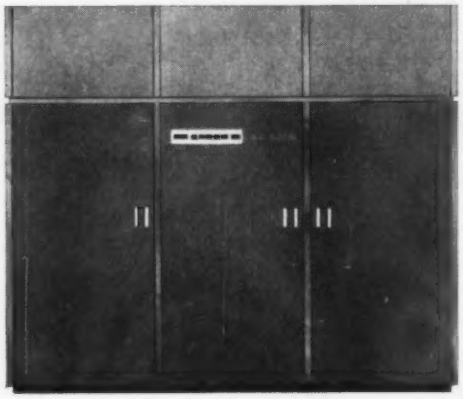
CITY_____ STATE_____

McGRAW-EDISON *Mail to Pennsylvania Transformer Division McGraw-Edison Company, Canonsburg, Pa.*

PENNSYLVANIA DISTRIBUTION REGULATORS



S-C 5200
CLOSE TOLERANCE PRINTING ON PRE-PRINTED FORMS



Newest of the S-C 5000 Series High-Speed Electronic Printers, S-C 5200 Registration Printers are specially designed for commercial applications requiring close tolerance registration of computer data on pre-printed forms. Printing up to 5,000 lines per minute — five to ten times faster than electro-mechanical printers — S-C 5200 Registration Printers provide unequalled efficiency and economy in large-volume processing of invoices, statements, premium notices and inventory records.

Send for complete information concerning S-C 5200 Registration Printers. Ask for Bulletir 6-E. Write today: Stromberg-Carlson — San Diego, 1895 Hancock Street, San Diego 12, California.

GENERAL DYNAMICS
STROMBERG-CARLSON DIVISION

The Electrical Week

LATE NEWS ▶ **In the Pacific Northwest** . . . Oregon legislature gets resolution aimed at power-company ads concerning "matters not affecting the sales of electricity, and which concern political and other matters." Measure proposes creation of a committee to see whether state laws should be tightened . . . Sen Richard Neuberger (D-Ore.) introduces Columbia River Development Corp bill without waiting for any co-sponsors. In 1958 he had seven co-sponsors.

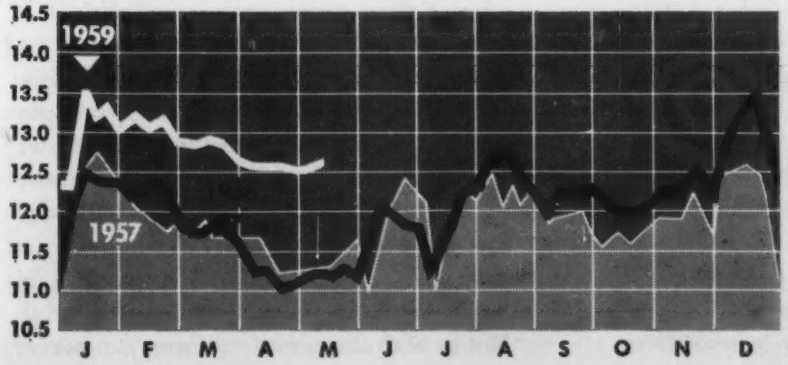
Brazilian official prepares to expropriate U.S. utility. Leonel Brizzola, Labor Party governor of the State of Rio Grande do Sul, signed a decree last week preparing for the expropriation of American & Foreign Power subsidiary Companhia Energia Electrica Rio Grandense, which operates in Porto Alegre. A&FP says property is a $15 million investment, and that the move had come as "a surprise to us."

FPC examiner authorizes sales of 100 million cu ft of natural gas to Southern California Edison for generation to alleviate smog problem in Los Angeles. This contrasts directly with recent FPC denial of Consolidated Edison bid to burn natural gas for similar reasons.

Added co-op-power company friction in Indiana may result from Indianapolis P&L proposal for $125 million plant on 370 acres it owns next to Petersburg site of Hoosier Electric Energy, Inc, an organization of co-ops which plans a $42 million steam plant there.

Management changes . . . West Penn Power elects H. W. Swartz vp . . . E. A. Fontaine is new vp, engineering and operations at Puget Sound P&L . . . Kansas City P&L names P. L. Metzger vp . . . Robert Resor new vp at Bozell & Jacobs . . . R. M. Hatfield, formerly manufacturing vp at Combustion Engineering, is appointed vp and general sales manager in charge of domestic sales, reporting to D. S. Walker.

WEEKLY POWER OUTPUT—UP 11.9% (Week ending May 9), Kwhr 12,659,000,000



Per Cent Change From Previous Year

	April 25	May 2	May 9
Total U. S.	+11.9	+11.5	+11.9
New Eng. ...	+ 7.3	+ 9.8	+ 4.6
Mid. Atlantic ..	+10.2	+10.0	+ 6.1
Cent. Ind.	+15.9	+16.0	+16.3
West Cent. ...	+10.7	+10.6	+14.1
Southeast	+ 7.5	+ 5.9	+ 7.9
South Cent. ...	+12.9	+13.5	+20.5
Rocky Mount..	+14.2	+15.7	+10.0
Pacific			
NW	+ 6.8	+12.6	+16.3
SW	+20.2	+13.1	+11.7

Seasonally Adjusted Index 255.1

Week Ago 253.6 Year Ago 227.5

Source: Edison Electric Institute

Preview of this Issue

EVENTS ▶ **As first electric cars begin rolling off production line,** EW turns to four men who are rejuvenating interest in battery powered vehicles for views on prospects of the future. The consensus: Outlook is good. Cover story starts on **p 62** . . . Rich bauxite deposits in Africa's newly independent Ghana will be tapped by a Volta River hydro scheme delivering a total of 975 Mw **(p 64)** . . . House passage of TVA bond bill points to Presidential veto possibility, if Senate endorses the measure as it now stands **(p 66).**

ENGINEERING ▶ **The debate over residential service voltage continues.** Ebasco's A. S. Anderson tells why he thinks 240/416 v is best for new homes on **page 86** . . . Commonwealth Edison's F. A. Cox argues for 240/480 v on **page 82** . . . TVA engineer R. M. Gardner describes the Authority's new 500-Mw Unit No. 7 at Widow's Creek. Estimated cost is $172 per kw **(p 70)** . . . Standardization of power centers and primary distribution cables cuts first costs while it ups reliability at Ormet Corp's new alumina plant at Burnside, La. **(p 68).**

PROCUREMENT & PRODUCTS ▶ **Proposed 50¢-a-ton cuts in coal freight rates** to North Atlantic ports runs into snag as oil competition asks ICC to delay effective date beyond May 15. The ICC could turn down the railroads' petition on this

Politics and Public Power

AN INTERESTING QUESTION

Some recent advertising by the Washington Public Utility Districts' Assn in Seattle —advertising that concerns "matters of public controversy"—raises some interesting questions about the rights of the privately-owned electric utilities in the area to answer it.

If the now-pending Electric Companies Advertising Program (ECAP) cases before the Internal Revenue Service (for tax purposes) and the Federal Power Commission (for rate-making purposes) go against the investor-owned companies, they will not be able to treat, as necessary and proper business expenses, the costs involved in answering charges such as these from a WPUDA ad. . . .

The ad shows a lineman atop a pole, and is headlined, "How Many Times Will You Pay for this Pole?" The ad's body copy answers the question in the following manner:

"If you are served by a PUD, you pay only once (in your electric bills) for the facilities which bring you electricity. They belong to you—the public—debt-free.

"If you are served by a private monopoly power company, you pay for the company's system again and again but never acquire an interest, or a debt-free equity."

The ad then claims that the public's debt-free equity in the state's PUD's increased another $8 million in 1958 to $62.4 million. It goes on to point out that as the PUD pays off its bonded indebtedness and increasingly finances expansions out of revenues rather than by borrowing, the public's debt-free equity grows. This, it says, is similar to an owner's growth of equity as he pays off his home or farm mortgage.

Not so with the private company, however,

basis . . . Industrial production forecasts creeping upward **(p 92).**

MANUFACTURERS ▶ **A new cable coupler that makes possible a 7.5-kv extension cable** is being marketed by PLM Products, Inc, Cleveland . . . Federal Pacific Electric announces "Insul-glass," a glass-reinforced polyester for use in bus bar insulation, bus supports and 5 and 15-kv phase barriers in metal-clad switchgear **(p 94).**

NEW EQUIPMENT ▶ **Boiler feed pump motors can be disassembled in five minutes** for inspection . . . Hot-stick tester can be carried and operated by one man . . . Molded indoor current transformers in ratings from 10 to 1,200 amp are available for utility and industrial applications **(p 101).**

MANAGEMENT ▶ **Do REA co-ops still need subsidies?** Financial statistics published in the most recent annual report of Rural Electrification Administration borrowers seems to indicate that they do not. Surplus of REA borrowers has been mushrooming, and there's evidence that some of the 2% money has been reinvested in higher-yield securities **(p 119).**

SELLING ▶ **Georgia Power's Merchandise Sales Plan appraises appliance sales** from an electrical revenue standpoint, rather than price **(p 138).**

says the ad. Here the public is only a "renter" of power, and "In the long run, the difference between 'buying' your own public power system and 'renting' from a private power company is readily apparent. The growing debt-free equity means lower rates . . . As a power system 'buyer,' you pay off the system's debt in your rates only once. But as a 'renter,' the rent goes on forever with no advantage to you."

Leaving aside the particulars of the ad itself—they raise more questions than they answer—a very much more important inequity is brought into focus by its very existence: Is it really fair to challenge the right of the investor-owned utilities to plead their cause, as a necessary and proper business expense, moreover to express this challenge through taxes and the rate base, and to then allow the non-regulated, non-federal-tax-paying public utility districts to go unchallenged?

The Northwest Electric Light & Power Assn, made up of private utilities in Idaho, Oregon, Montana and Washington, does not think so.

The Association has published a flyer reproducing the ad and attacking it as unfair play. In addition to pointing out that the PUDs pay no federal income taxes, and that most of the money of its public indebtedness was raised through the sale of tax-free bonds, it also emphasized that its members must have the right to answer on equal terms: "If they are to stay in business, investor-owned utilities MUST retain the right to answer through ads (the only means available to them) such as (this) one which was paid for by the customers of public utility districts . . ."

It is hard to overlook—and even harder to refute—the merits of their case.

Executive Reader

Aggressive promotion of electric house heating can be justified on the basis of offsetting summer peak loads, increasing the margin of winter load over the growing summer load, or because electric heating is a profitable load. West Penn Power is aggressively selling this load for the third reason. **R. G. MacDonald, West Penn Power Co, System Planning Committee meeting, PEA, Greensburg, Pa., May 1959.**

City-bred commuters are the Big New Problem facing many rural electric cooperatives. "The Anoka Story" tells how one rural system is moving to make ex-city families members of the co-op in spirit as well as name through an intensive commuter-oriented member education program. **Rural Lines, April 1959.**

Work output averages 9% more for employees in air conditioned office space than for workers in similar, non-air conditioned offices, while absenteeism averages 2.5% lower for the air conditioned space. In office work where rate of production is not standardized, or where no minimum requirement must be met consistently, increase in productivity will more than pay for air conditioning through savings in salaries. **Influence of Air Conditioning on Work Production, Public Buildings Service, US General Services Administration.**

Condensate leakage in water systems of ultra-high purity frequently contributes the greatest amount of solids into the system. Condensate and feed water can be purified internally through use of high-rate scavengers of condensate for sub-critical and supercritical once-through boilers as well as sub-critical drumtype boilers. **V. J. Calise, Graver Water Conditioning Co, E&O Section Conference, SEE, Belleair, Fla., April, 1959.**

Reduced cost through more mechanization and improved methods for construction, operation, and maintenance on overhead distribution systems is the goal of a new service for utility companies. A second objective of the service is effective use through mechanization of older personnel who cannot continue climbing. **Ebasco News, April 1959.**

Meter reading by radiophone has replaced the meter book around the system of a North Carolina municipal utility. The meter reader reports, via walkie-talkie, the meter number and reading directly to a billing clerk, who enters the data on a visual card file and computes the bill while the meter reader goes to the next meter. **Water & Light Dept, Monroe, N. C.**

L-M Kyle Type E 23 KV Recloser Now Interrupts 2500 Amps; Other Changes

More precise hydraulic mechanism; finger-tip choice of sequences; simplified contact construction permits conversion from 2.3 to 23 kv without changes.

By **LYLE McNULTY**
Application Engineer, Kyle Reclosers
Line Material Industries

L-M's Type E power class recloser has recently been improved to provide greater flexibility and convenience, a wider range of applications, higher interrupting capacity. Three Type E's may be electrically interlocked to provide 3-phase lockout when any one phase locks open.

Higher Interrupting Capacity

The Type E now provides interrupting ability 40 times coil rating, with a maximum of 2500 amperes, symmetrical, over the entire application range from 2.3 to 23 kv, without any addition or removal of parts.

Sequences Easily Changed

New, more precise and more versatile hydraulic mechanism. Improved timing control. Finger-tip choice of sequences. These can be changed in the field without special tools or any parts.

Simplified Construction

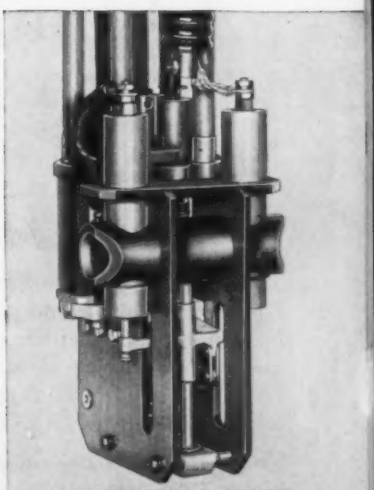
Contact buffer assembly simplified. No changes are necessary to convert from 2.3 to 23 kv in the field. Two identical contact tubes simplify maintenance, cut maintenance costs.

Improved Arc Extinction

Arcing chambers designed to give quick interruption with minimum of arc energy at high fault currents, and to provide supplementary oil turbulence required for lower fault currents.

Get Complete Information

The new Type E provides the same high-quality performance that has made Kyle Reclosers the undisputed leaders in the field. Ask the L-M Field Engineer for Bulletin CR1B on the New Type E, and information on other Kyle Reclosers, including Kyle-Klad equipment. Or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: Canadian Line Materials, Ltd., Toronto 13, Ontario.



THE NEW HIGHER-CAPACITY arc-interrupter mechanism handles up to 2500 amperes at 23 kv. Two vented arcing chambers. Double break contacts driven by toggle spring to insure rapid opening and closing. Moving contacts have separate load transfer and arcing surfaces to insure long wear.

LINE MATERIAL® Industries Kyle® Reclosers
McGRAW-EDISON COMPANY

389

DISTRIBUTION TRANSFORMERS • KYLE RECLOSERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE AND CONDUIT

B&W Pulverizer Design Simplicity Cuts Maintenance

A Compact, Space-Saving Package of Efficient Grinding Power

Exceptional output and efficiency records . . . highlighted by low maintenance . . . have been established in hundreds of installations by B&W Pulverizers. Their long-range dependability has been accompanied by reduced operating costs.

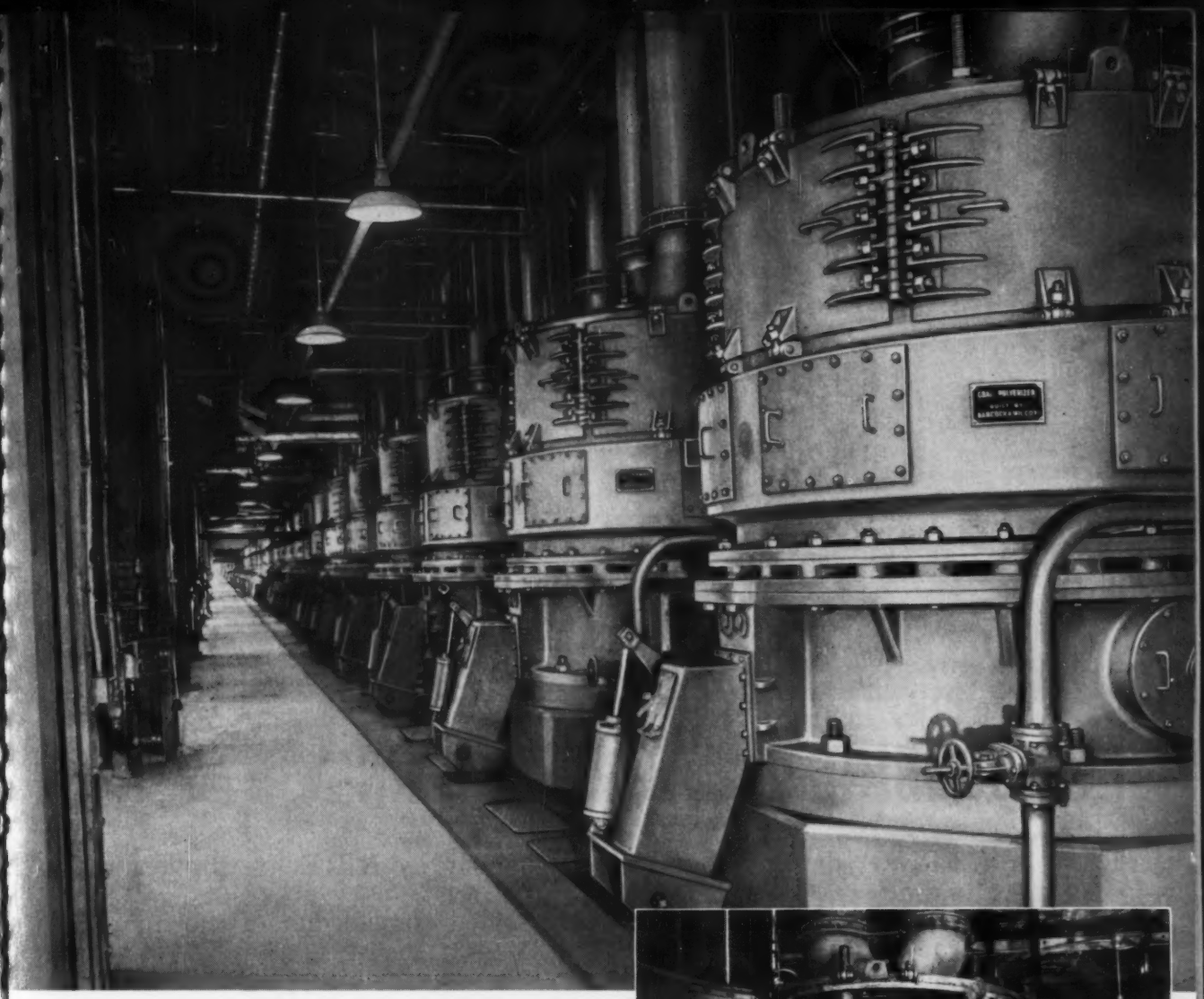
Simplicity of Arrangement and Reduced Maintenance: Accessibility for all normal maintenance makes it simple, quick, safe, and low-cost. Adjustments are easily made while the unit is in operation. Using only clean primary air supplied under pressure, fan maintenance is substantially reduced and fuel piping is greatly simplified. Also, with the pulverizer acting as its own distributor, no special distributing devices are needed. Grinding elements are of special alloy material. They last two years or more on eastern coals and at least a year on midwestern coals.

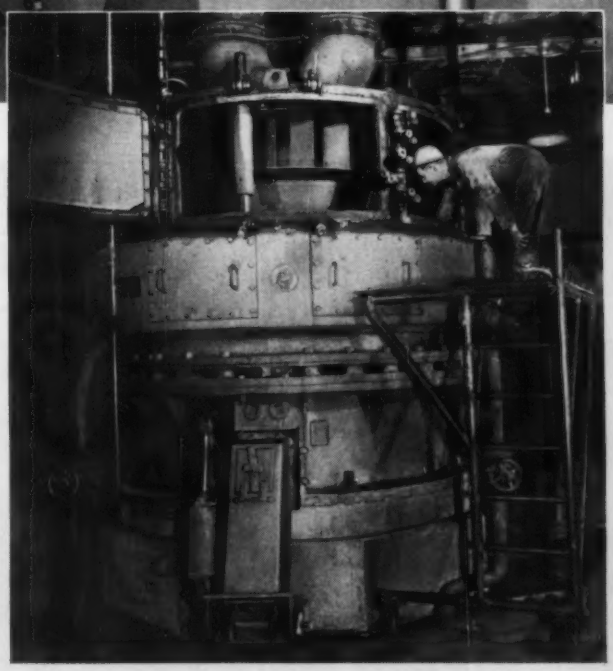
Continuous High Fineness Over Entire Service Life: Efficient combustion requires high fineness at all times. The high circulating load of the B&W Pulverizer permits efficient and dependable classification of product, so that only material of proper fineness leaves the unit. In addition, its slow-speed, spring-loaded ball bearing grinding elements maintain proper grinding contact throughout their service life.

Handles Wide Variety of Low Grade and Wet Coal: Regardless of the coal's grade or whether it's dry or soaking wet, the B&W Pulverizer's unique and exclusive recirculation of fuel through heated air assures efficient grinding . . . eliminates shutdown, capacity loss, or special attention from operators.

Adaptable to All Types of Automatic Controls: Because it features "one point contact with the

G-924





(Above) Part of the 42 B&W Pulverizers serving six B&W Open-Pass Boilers. (Right) Maintenance is simple: doors open wide, classifier and spring assemblies are readily accessible for removal. Grinding components are lifted without special rigging.

boiler," operation of the B&W Pulverizer is simple. The boiler's automatic combustion control is connected to the pulverizer at only one point—the damper in the primary-air duct. The pulverizer's own control system regulates all other functions, such as maintenance of proper fuel-air ratio and operating temperature.

SEND FOR DATA. For full information about the B&W Pulverizer and Pulverized-Fuel Firing Systems, write: The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

G-924

EXTERN-O-FUSE

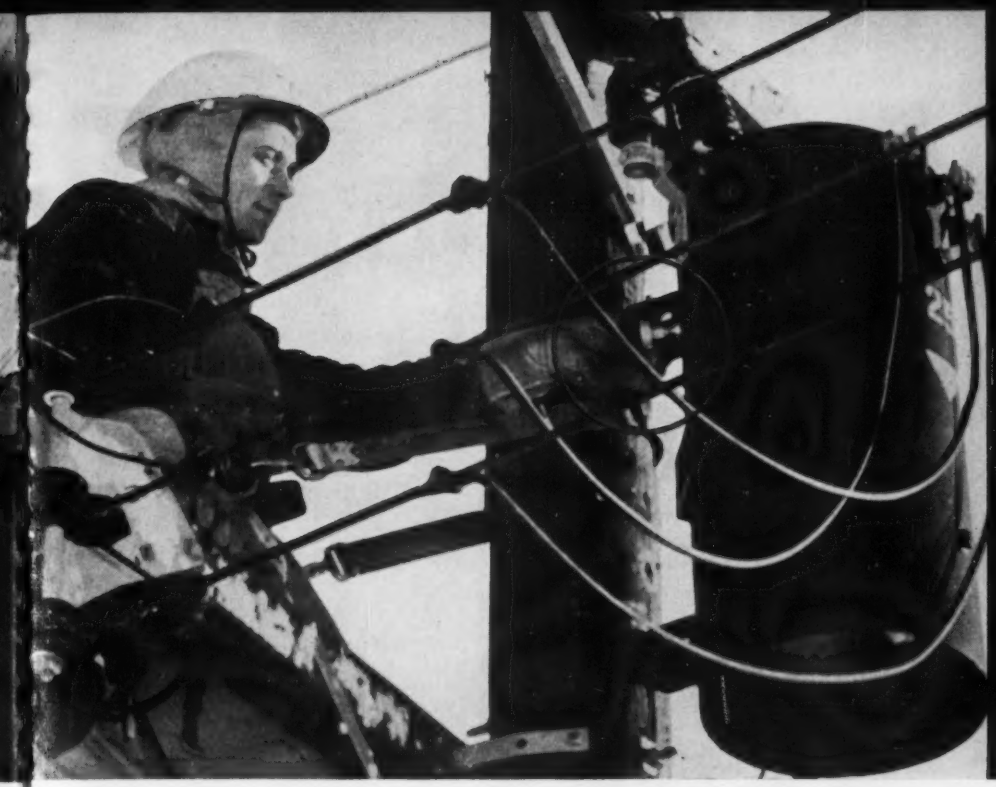
An externally-changeable, bayonet type high-voltage fuse now available on the RT&E Terra-Tran. This new fuse now makes replacement of blown fuses a relatively simple operation . . . they are removed and replaced without entering the transformer.

INTRODUCING THE RT&E EXTERN-O-SYSTEM

These "EXTERN-O" devices developed exclusively by RT&E are proven and in use today as they point to the completely sealed transformer of the immediate future. You can profit from their use today, their ultimate application tomorrow.

EXTERN-O-SWITCH

An externally-operated, primary voltage change-over switch, introduced first by RT&E almost three years ago on its dual-voltage transformer. Thousands of these switches are in use on dual-voltage transformers, saving utilities money in labor time, change-over time and transformer replacement cost.

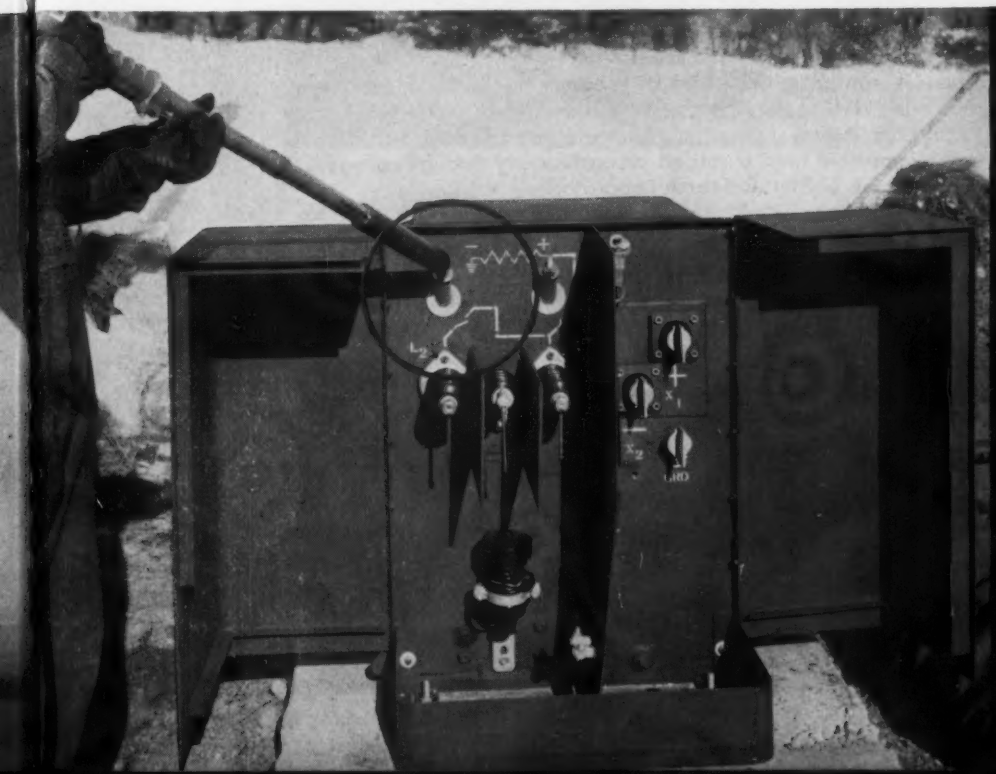


A safe, proven, externally operated tap changer made only by RT&E. With it, there is no handhole cover to remove, less danger on pole during service, no tap setting confusion, no oil contamination and fewer exposed parts to corrode.

THE WAY TO A COMPLETELY SEALED TRANSFORMER

Reduce operating and maintenance costs, increase personnel safety. Eliminate entering the tank, prevent oil contamination, extend life of the transformer.

RT&E CORPORATION • Waukesha, Wisconsin • Portland, Oregon



An externally-operable bayonet type disconnect switch now available on the RT&E Terra-Tran. With it, line sectionalizing for quick and easy isolating of faulted transformers or faulted cable is easily carried out.

CC

BARTLETT

More than 12 years ago Bartlett successfully pioneered the use of the helicopter for shade tree spraying—an operation that was to lead the way, a few years later, to a new efficient method of control of woody plants along utility rights-of-way.

At first, difficult terrains presented unusual problems but gradually through research and experience, new equipment was developed and new herbicides and techniques perfected to overcome them. Today, Bartlett research in this important field is carried on continuously through college fellowships and at the Bartlett Research Laboratories.

If your right-of-way clearance, line trimming, brush control or tree survey requirements present a problem, we invite you to share our years of experience. This service is now available from Maine to the Carolinas, and west to Indiana.

The Bartlett Way

BARTLETT TREE EXPERTS

Home Office, 2770 Summer Street, Stamford, Conn.
Research Laboratories and Experimental Grounds, Stamford, Conn.
Bartlett School of Tree Surgery, Stamford, Conn.

The industry's most modern methods of producing a bushing core impart to O-B's design a unique degree of hardness and strength. These desirable qualities are exploited to produce the strongest bushing in nearly 50 years of manufacturing experience.

Many points of firm contact are established between the core and ground sleeve structure, thereby augmenting over-all rigidity. This is distinctly an O-B construction principle.

Higher physical strength assures safer shipment. It reduces possible damage by careless handling. And then - - in service - - it gives a lifetime of better support for circuit breaker parts, and higher resistance to other strains inherent in bushing application.

Your new apparatus can have O-B bushing protection so easily that you can't afford to miss it. Simply express your choice of bushings when ordering transformers and circuit breakers.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

Ohio Brass HOLAN

PORCELAIN INSULATORS · LINE HARDWARE · CAPACITORS · LIGHTNING ARRESTERS
BUSHINGS · HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES · BRONZE VALVES

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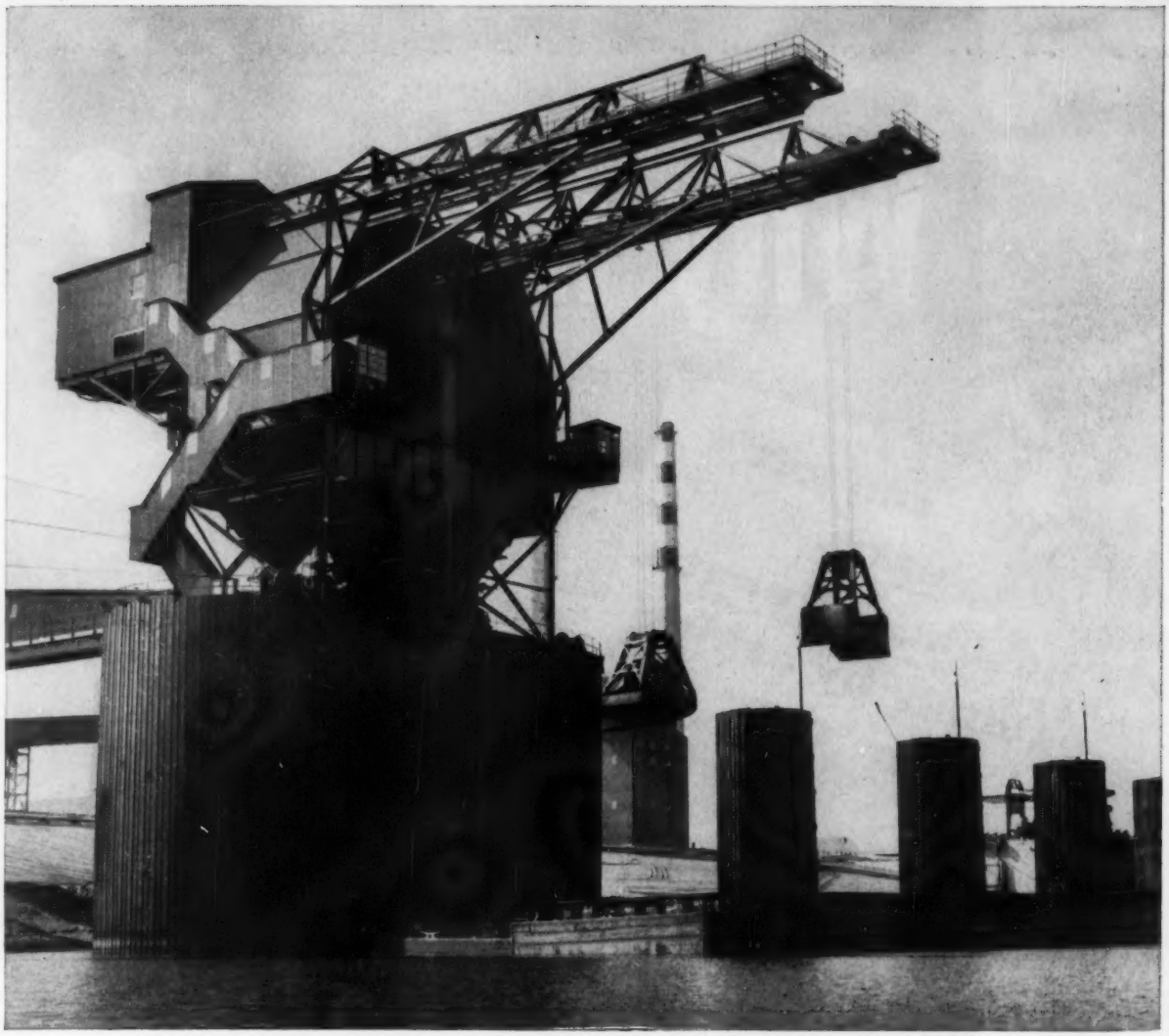


Dravo builds world's largest coal unloading tower at Memphis

New "Siamese twin" unloader serves 812,500-kw power plant

The world's largest coal unloading tower, designed and built by Dravo, is now serving the new 812,500-kw capacity Thos. H. Allen Generating Station at Memphis, Tenn.

This is the largest steam power plant ever authorized at one time by any municipality and was designed by Burns and Roe, Inc., of New York City, who also supervised plant construction.

Dubbed "the Siamese twins," the new unloader consists of two towers on a single base. Each of the two unloading units operates a 13.3-ton capacity bucket, with individual adjustable voltage control.

This unloader has a digging capacity of 2600 tons of coal an hour — 1300 tons per unit.

Separate welded, triangular booms are provided for each bucket trolley. Integrated design of the booms, with compression members into the tower, results in a structure of low height — 126 feet.

Find out more about how Dravo design and building know-how can help solve your coal or ship unloading problems. Contact DRAVO CORPORATION, Pittsburgh 25, Pennsylvania.

DRAVO
CORPORATION

new look in

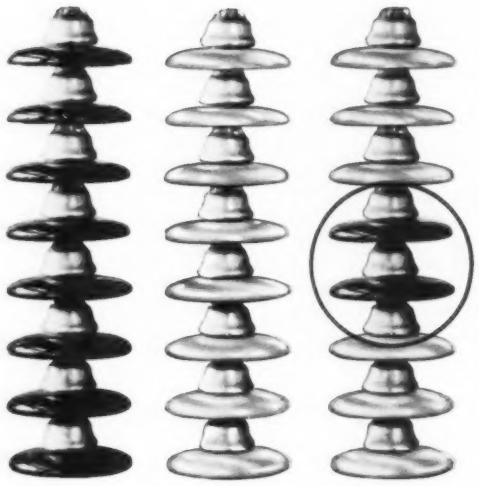
HIGH STRENGTH insulators

COLOR CODING

Progress Is Our Most Important Product

GENERAL ELECTRIC

NEW COLOR CODING takes the guesswork out of insulator identification!



BROWN 15,000 LB. | GRAY 25,000 LB. | AVOID THIS

Color coding offers a positive, at a glance solution to the presently existing industry wide intercoupling problem for 15,000 lb. and 25,000 lb. suspension insulators. Continuous ceramic research has produced a new gray glaze. This insures equally high impact and mechanical strength to our time proven mahogany high compression glaze.

This General Electric *progress* simplifies insulator identification in the crate, at the warehouse, on the line trucks, during field assembly, and on the line in service. Color coding makes insulator identification immediate and foolproof for the stock clerk, the inspector, and the lineman. It can mean time saving and peace of mind in your operations. Thousands are already in use.

Simplifies Line Patrol

The neutral gray appearance provides a natural protection against promiscuous "target hunters." In addition, laboratory tests show that flashover burns are readily detectable from ground or air. The gray compression glaze affords a distinctive contrast with the white underporcelain for breaks or burns.

COLOR CODING denotes High Strength-High Quality

New color coding on our high strength 25,000 lb. units changes the insulator in appearance *only*. The same *high quality mechanical* and *electrical* characteristics of our high strength porcelain are retained with the new gray color. Yes, the price is the same, too.

Color coded gray insulators are available in all three spacings (4¾", 5", and 5¾") of our new XHS 25,000 lb. suspension insulators (*Locke Cat Nos. 18253, -4, and -5). For additional information about the "*New Look*" in insulators, contact your Insulator Department representative, or write directly to Insulator Department, General Electric Company, P. O. Box 57, Baltimore 3, Maryland.

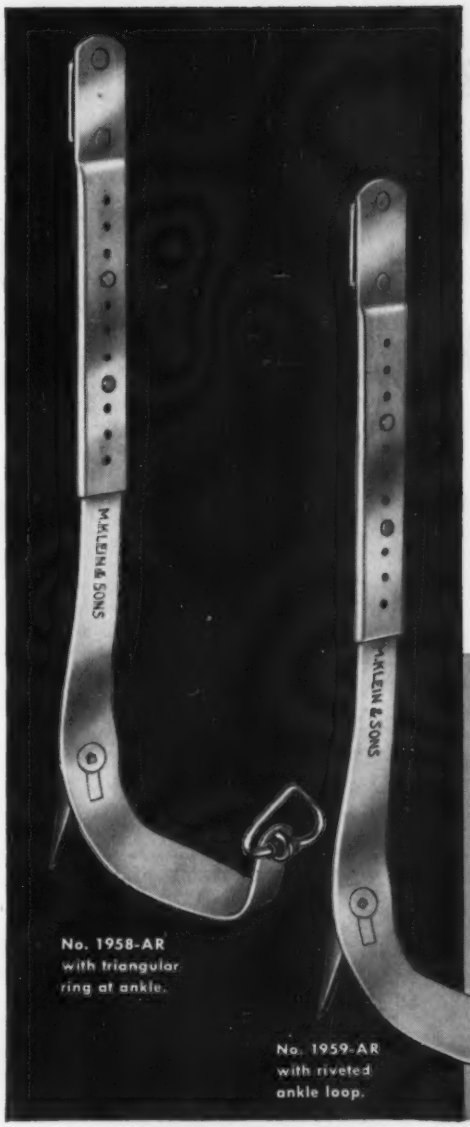
*Trademark General Electric Company

Progress Is Our Most Important Product

GENERAL ELECTRIC

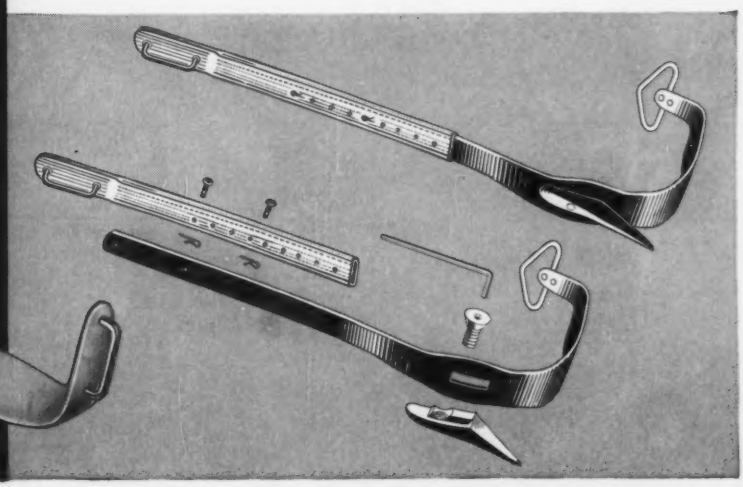
NEW!

KLEIN REPLACEABLE GAFF ADJUSTABLE CLIMBERS



No. 1958-AR with triangular ring at ankle.

No. 1959-AR with riveted ankle loop.



ADVANTAGES OF KLEIN REPLACEABLE GAFF ADJUSTABLE CLIMBERS

- Leg irons drop-forged from select electric furnace steel individually heat-treated and tested.
- Replaceable gaffs 1⅝ inches long measured on underside are drop-forged from electric furnace alloy tool steel, individually heat-treated and tested.
- Special screw with locking nylon insert anchors gaff firmly in position.
- Screw does not absorb any load when climber is in use.
- Leg irons fully polished in the critical section before finishing.
- Tilted stirrup provides maximum comfort.
- Extra clearance in stirrup adds comfort by firmly supporting entire width of arch.
- Heat-treated strap attachments assure maximum wear.

These new Klein climbers have been developed to meet the demand for a replaceable gaff adjustable climber that assures maximum quality and safety. For maximum safety, we recommend the leg iron be replaced after three sets of gaffs have been used.

The easily replaceable gaff is held in position by a self-locking screw. The full impact when using the climber is absorbed by the gaff and leg iron. No load is transmitted to the self-locking screw.

Adjustable to 14½, 15, 15½, 16, 16½, 17, 17½, 18, 18½ and 19 inches. Made in matched pairs, right and left. Wide stirrup gives full support. Offset shank brings gaff in proper line with the leg bone, assuring greater security and comfort. Aluminum finish. Every climber individually tested.

ASK YOUR SUPPLIER

Foreign Distributor: International Standard Electric Corp., New York

Mathias **KLEIN** & Sons

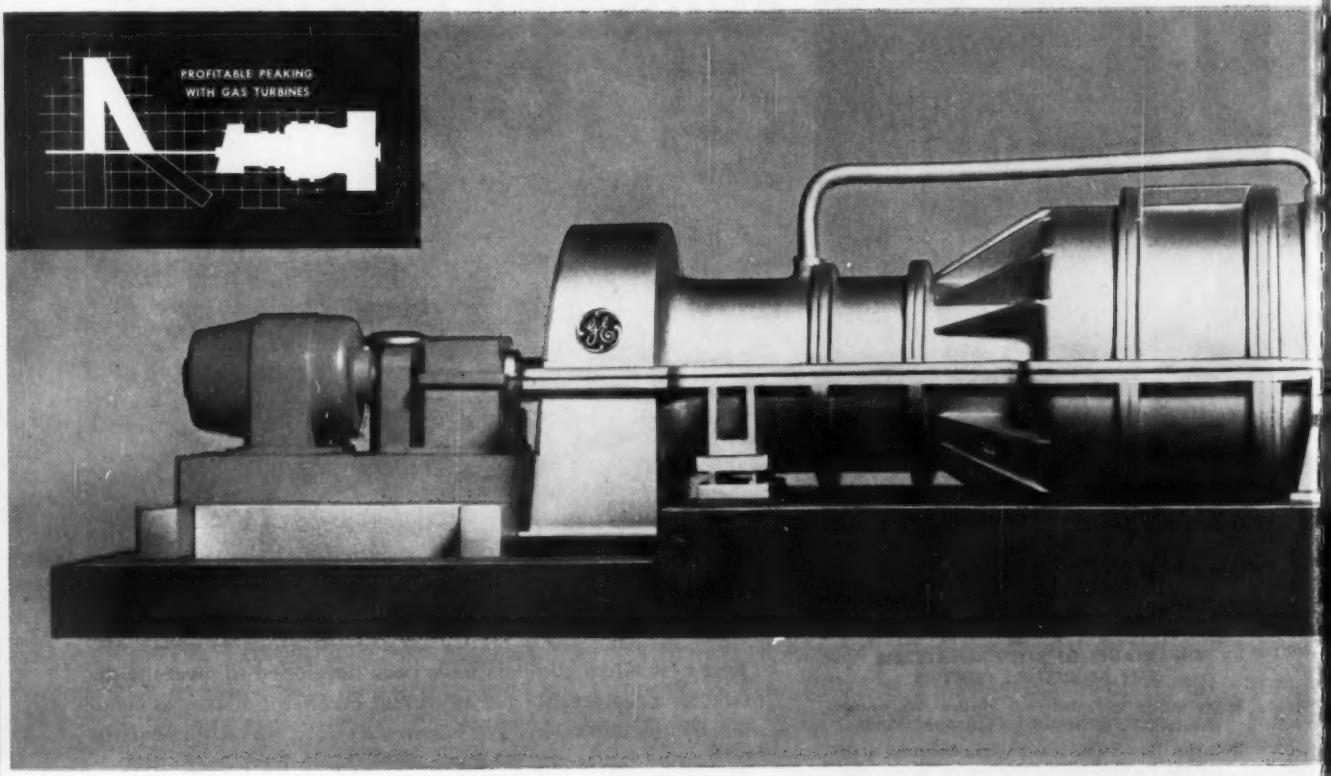
Established 1857 — Chicago, Ill., U.S.A.

7200 McCORMICK ROAD • CHICAGO 45, ILLINOIS

Write for Bulletin No. 559, giving full information on Klein replaceable gaff adjustable climbers.

NEW General Electric Gas Turbines

20,000-



Designed specifically to help electric utilities meet expanding peaking requirements, General Electric's NEW gas turbine for peaking service now offers high output—20,000 to 25,000 kilowatts—from one compact, completely automated, low-cost unit.

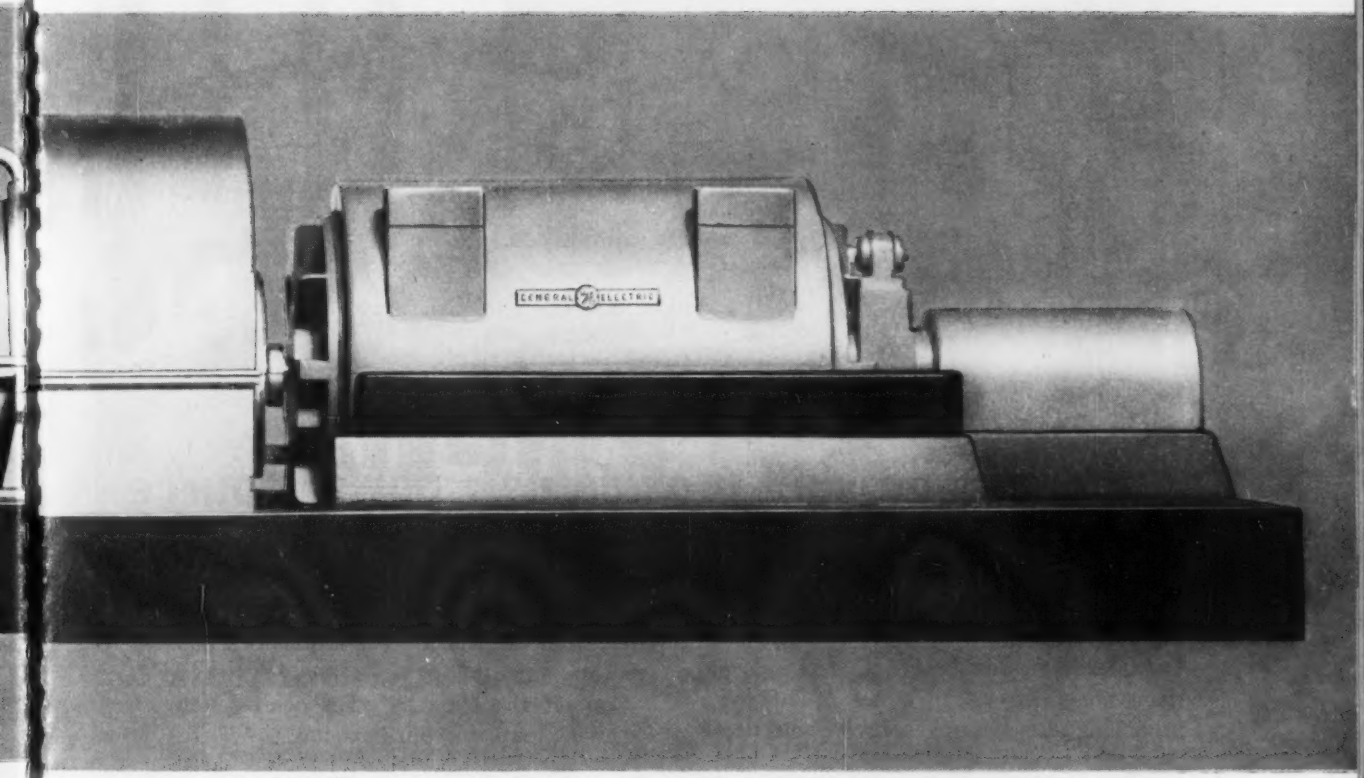
HIGH-CAPACITY peaking gas turbines represent a reliable and practical solution for present and future utility peak loads. Here's why: Higher kilowatt ratings in one unit keep control complexity and total number of units at a minimum—thereby simplifying system operation and maintenance procedures.

FOR MOST SYSTEMS this gas turbine size offers appreciable savings in bulk transmission investment. Negligible cooling water requirements mean almost complete site flexibility. It is now possible to achieve sufficient peaking capacity with the addition of a practical number of low-cost gas turbine units.

WITH OVER 3,000,000 operating hours of proven experience reflected in the design of the new peaking

for Peaking Deliver High Output . . .

25,000 Kw



gas turbine, General Electric offers a versatile prime mover plus experienced and trained personnel to help you with your specific peaking problem. If you are presently evaluating, or plan to evaluate your system's peaking requirements, your nearby General Electric Sales Representative will be glad to show you how peaking with high-capacity G-E gas turbines can save you dollars, or for additional information clip the attached coupon today and send to General Electric Company, Section 261-35, Schenectady 5, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

SEND TODAY FOR NEW PEAKING BULLETIN

General Electric Company
Section A261-35
Schenectady 5, N. Y.

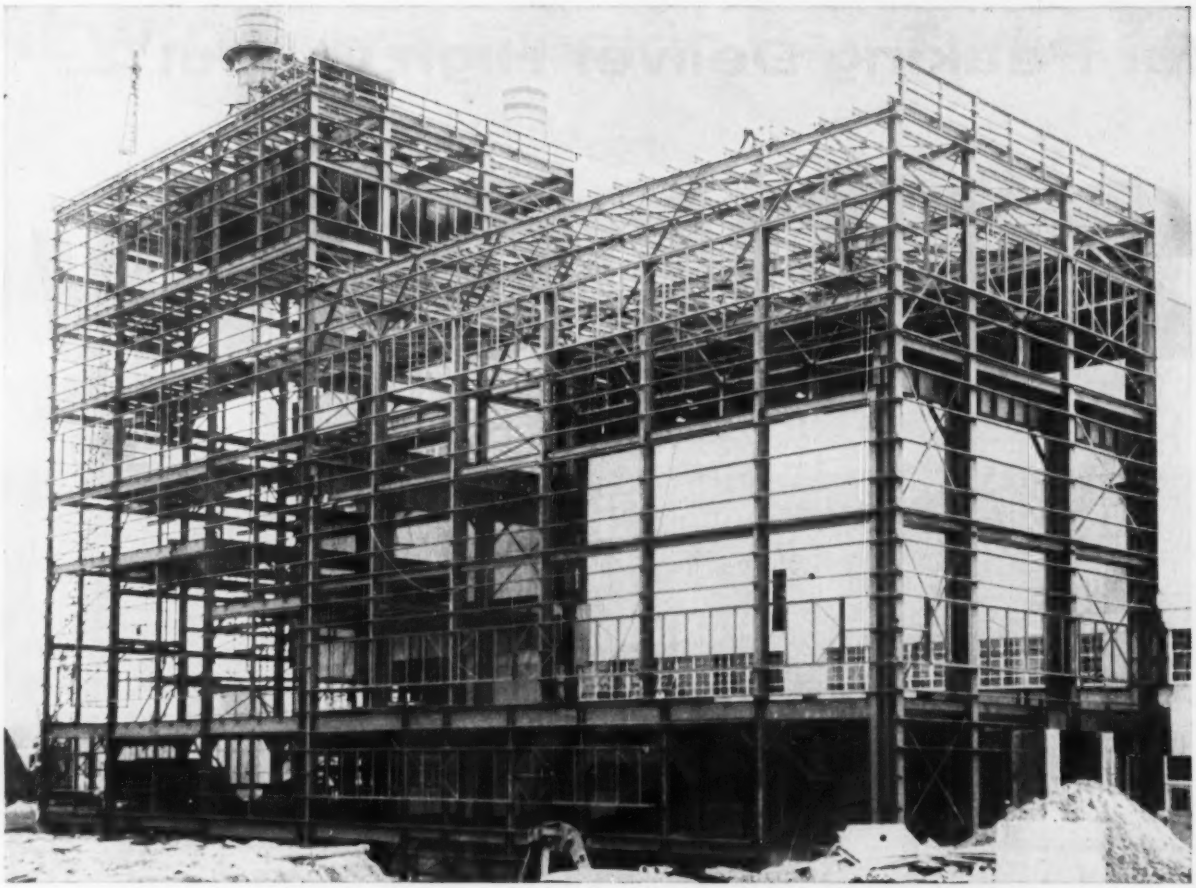
- ☐ Please send me bulletin GED-3761, "General Electric Gas Turbines for Electric Utility Peaking."
- ☐ Please have a G-E Sales Representative call on me.

NAME_____ TITLE_____

COMPANY_____ PHONE_____

ADDRESS_____

CITY_____ STATE_____



Experience and skill provide new power source

...with Structural Steel fabricated by INGALLS*

INGALLS fabricated structural steel is again rising above Mississippi's City of Gulfport, promising an additional source of electrical power for the growing Gulf Coast.

More than 1550 tons of structural steel and platework are being furnished and erected by INGALLS for Unit No. 2 of Mississippi Power Company's Gulf Coast Steam Plant at Gulfport. INGALLS also fabricated and erected the structural steel for the first unit. Power plants for 46 leading power companies throughout the United States are evidence of INGALLS' specialized skill and experience.

Precise planning and attention to every construction detail has built for INGALLS a reputation as expert steel fabricators and erectors.

Contact the INGALLS office nearest you for an estimate on your next job.

*1550 tons of INGALLS fabricated structural steel, platework and stack are included in the new Gulfport Plant, which will be a 100,000 horsepower generating plant between Gulfport and Biloxi on the Mississippi Coast.

STEEL PLATE FABRICATORS ASSOCIATION FOUNDED 1933

AISC

THE INGALLS IRON WORKS COMPANY
Executive Offices
BIRMINGHAM, ALABAMA

INGALLS INDUSTRIES ARE: **The Ingalls Iron Works Company,** Sales Offices: New York, Pittsburgh, Chicago, Houston, New Orleans, Atlanta • **The Ingalls Steel Construction Company,** Sales Offices: New York, Chicago, New Orleans, Pittsburgh, Houston, Atlanta • **Birmingham Tank Company,** Sales Offices: New York, Pittsburgh, Chicago, Atlanta, New Orleans, Pascagoula • **The Ingalls Shipbuilding Corporation,** Shipyards: Pascagoula, Mississippi; Decatur, Alabama Sales Offices: New York, Chicago, Washington, Houston, New Orleans, Atlanta

ALLIS-CHALMERS modern line for '59

. . . simpler regulator control

- **Provides more accurate settings**
- **Saves operator's time**
- **Eliminates customer complaints**

Now when you adjust or test voltage level and band width there's no need to change customer voltage. No more customer complaints of high or low voltage. With *Caliband* control the job is simpler than ever before. Adjusting a single knob is all it takes . . . operator's time for accurate settings is greatly reduced.

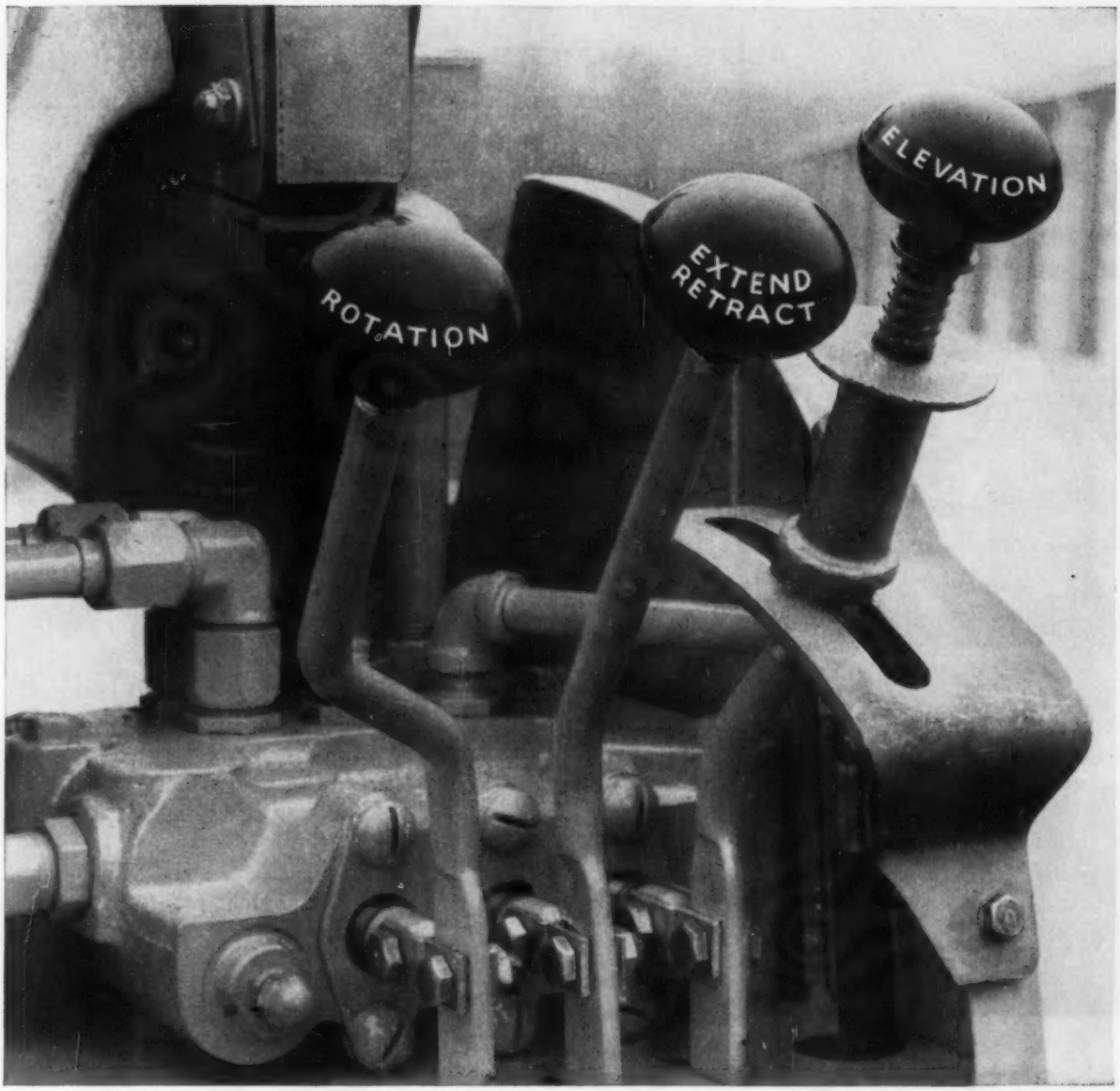
CALIBAND control demonstrated

Caliband control is so simple it can be demonstrated and explained at your desk with an actual unit in a small portable kit. Contact your nearby A-C office for a demonstration, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS
Originators of 5/8% Step Regulators

A-5912

Caliband is an Allis-Chalmers trademark.



Complete Ladder Control

Any ladder can have control levers. The big difference is in what you can do with them. Complete control *should* be in the hands of the operator at all times.

This Holan all-hydraulic ladder goes where you want it to go because of a smooth operating valve with throttling grooves in the spools. It stays in position because of built-in check valves that lock the load when the ladder stops moving.

You can turn 360° either way, elevate up to 75° and extend and retract the fly ladder. There's no physical exertion; you just move the levers.

Accurate control is not a luxury. It saves time and it's safe. Ask your Holan Field Representative about this Series 2100 Ladder and other ladders in the industry's most complete line of aerial equipment. Write for catalogs about Holan hydraulic, mechanical and pushbutton ladders.

Holan Corporation, 4100 W. 150th St., Cleveland 35, Ohio
Plants in: Cleveland, Ohio; Griffin, Georgia; Phoenix, Ariz.

Holan

Subsidiary of THE OHIO BRASS COMPANY

HOLAN

ALLIS-CHALMERS modern line for '59

C. M. Ripple, plant superintendent, and L. O. Sharp, Jr., assistant plant superintendent at W. A. Parish power plant, shown with one of eight 138-kv Allis-Chalmers breakers in switchyard.

Look at the record at Houston Lighting & Power Company

H. C. Taylor, electrical supervisor Power Department, and A-C's J. O. Higgins in Deepwater power plant switchyard.

Ten Allis-Chalmers breakers with *Pneu-Draulic* operators have been in service nearly five years. Eight additional units installed a year ago bring to eighteen the total number in use by the company.

In fact, the excellent performance of Allis-Chalmers breakers with *Pneu-Draulic* operators has led to their use on over 100 power systems. Repeat orders have been received from more than 60.

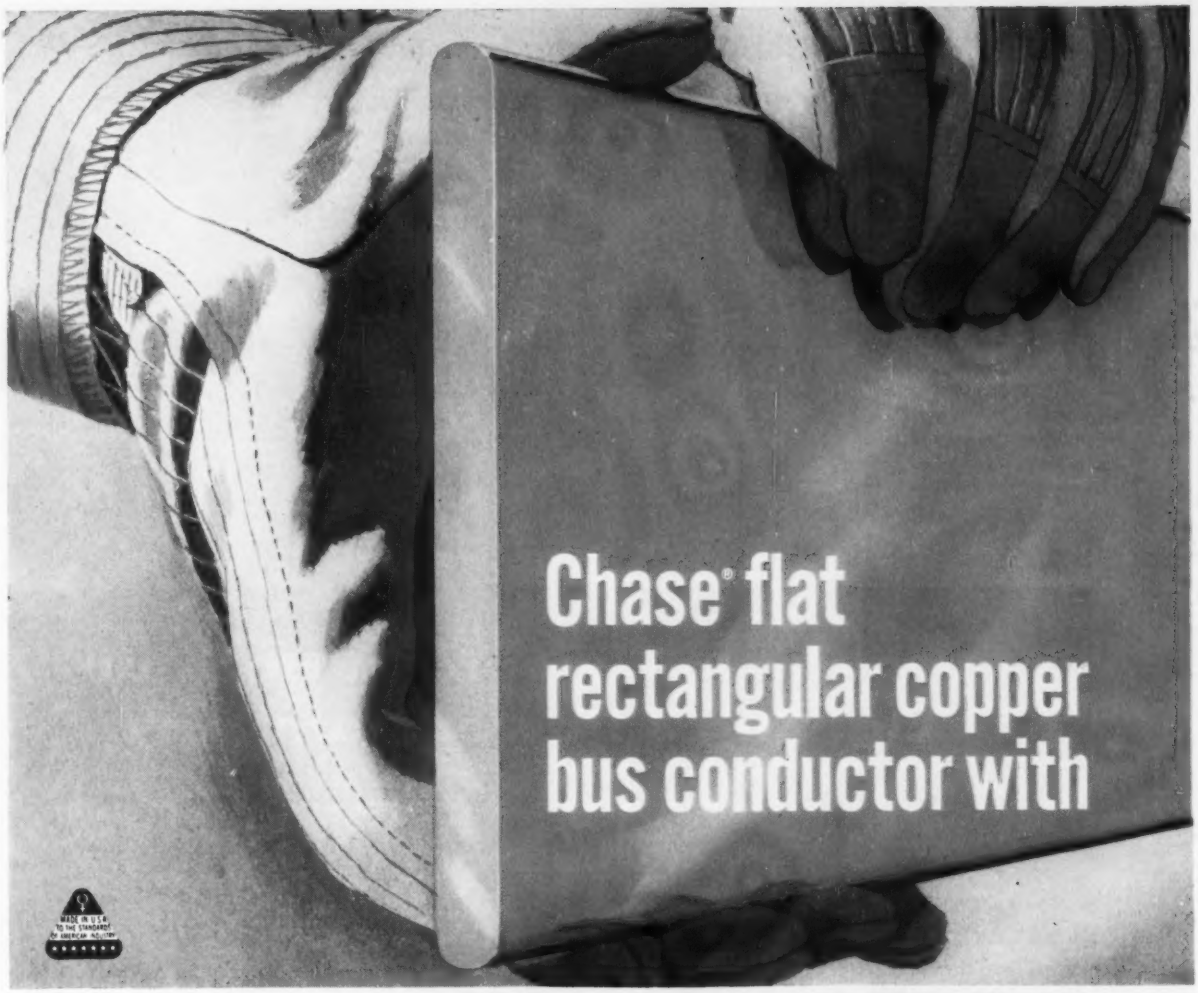
Behind this story is design leadership in power circuit breakers. A-C has led the way to fully mechanically trip-free operation and high speed arc interruption, as well as simplified operator design as represented by the *Pneu-Draulic* operator.

Get details from your nearby A-C office, or Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin

Pneu-Draulic is an Allis-Chalmers trademark.

ALLIS-CHALMERS

A-1035-E



FULL-ROUNDED EDGES

You can get top-quality copper bus conductor from Chase in flat bar shape with full-rounded edges, as well as bar with rounded edge or rounded or square corners.

The full-rounded edge bars have no edges to cut through insulating wrapping and cause trouble on the job. And they can be made up readily in multiple-bar units to handle very heavy direct current loads, or for alternating current.

Chase® flat rectangular, *full-rounded* edge bus conductor is ideally-suited to use in making up bus duct.

Chase also makes many special type bus conductors, for specific applications. If you have particular requirements, why not talk them over with a Chase Engineer? Call the nearest Chase Warehouse or Sales Office, or write Chase at Waterbury 20, Connecticut.

Chase®

BRASS & COPPER CO., WATERBURY 20, CONN.
Subsidiary of ***Kennecott Copper Corporation***

CHASE ELECTRICAL CONDUCTORS
are available in a variety of shapes
to suit every power-carrying need.

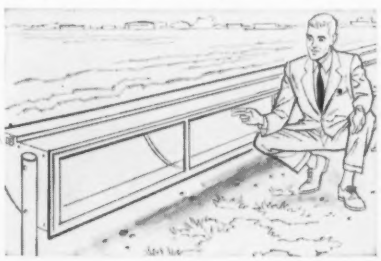
THE NATION'S HEADQUARTERS FOR **ALUMINUM • BRASS • BRONZE • COPPER • STAINLESS STEEL**
Atlanta Baltimore Boston Charlotte Chicago Cincinnati Cleveland Dallas Denver Detroit Grand Rapids Houston Indianapolis Kansas City, Mo. Los Angeles Milwaukee Minneapolis Newark New Orleans New York (Maspeth, L.I.) Philadelphia Pittsburgh Providence Rochester St. Louis San Francisco Seattle Waterbury

The Sylvania CFR system brings to airports a greater degree of illumination that reflects the pattern of runway white paint markings . . . brings out texture irregularities in runway surface . . . aids pilots in depth perception as well as guidance on landing speed and angle of approach

Before the Sylvania CFR lighting system, "black holes" existed between incandescent beacon-type lights that still line many airport runways

Washington National Airport... spreads a carpet of light with Sylvania CFR lighting system

A newly developed Sylvania lighting system for runways enables planes to land more quickly and safely regardless of visibility conditions. This major advance toward all-aircraft, all-weather operations is particularly important because today's larger, faster planes use more of a runway's length than earlier planes.



Developed co-operatively with the FAA, this new system provides a continuous, broad ribbon of light across the entire width of the runway. At Washington National Airport's instrument runway 36, each 200-watt Sylvania VHO (Very High Output) fluorescent lamp in an 8-foot CFR (Controlled Fluorescent Reflectance) fixture produces a light output of 13,250 lumens. This is possible because Sylvania VHO lamps deliver more than 2½ times the light of ordinary fluorescent tubes.

136 VHO lamps are installed in CFR fixtures along each side of the runway, for a continuous 1400-foot path of light broken only by an intersecting taxiway. The complete installation produces about 3.25 million lumens of light!

A revealing test for this new lighting system came during early-morning, near zero-zero visibility conditions when incoming pilots reported "little glare, good runway texture and good height guidance" from the VHO runway strip lights.

For full information on new Sylvania VHO lamps and the CFR system—and how they can provide superior lighting at lower cost—call your Sylvania representative, or write:

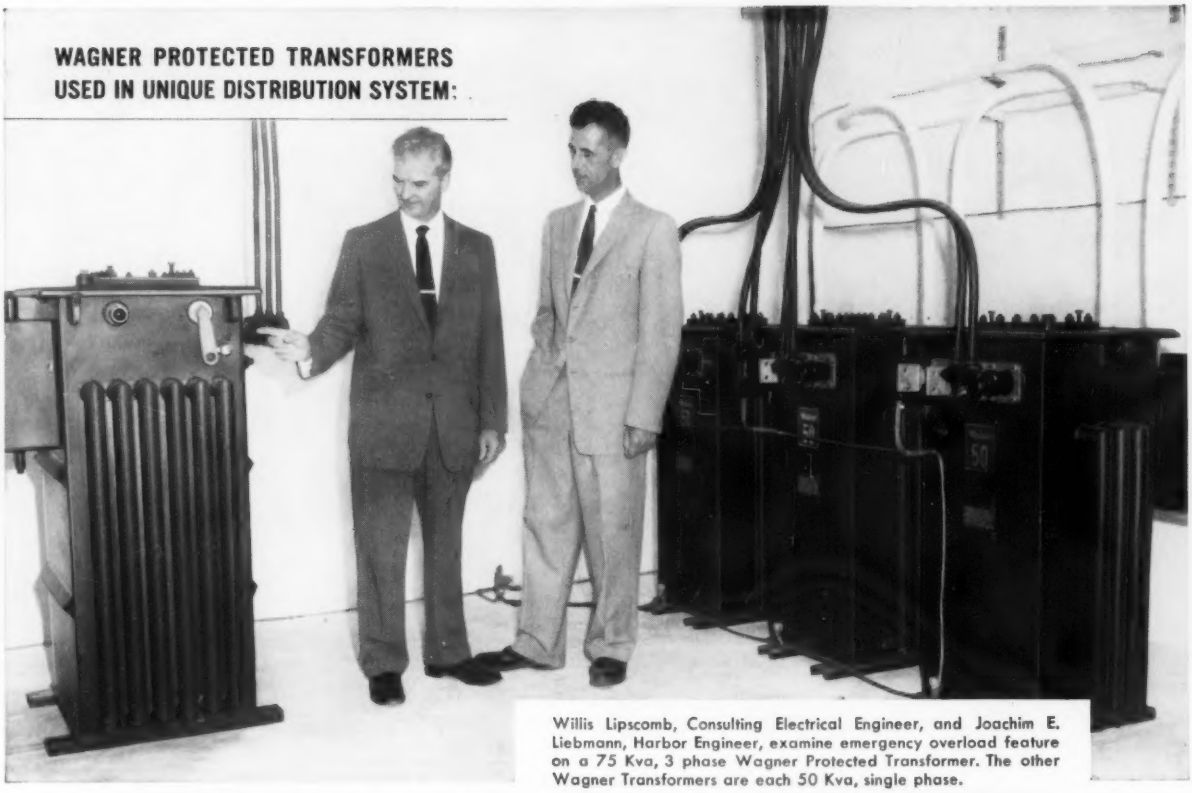
SYLVANIA LIGHTING PRODUCTS
Dept. 9L-7605, 60 Boston St., Salem, Mass.
In Canada: Sylvania Electric (Canada) Ltd.
P. O. Box 1190, Station "O", Montreal 9

SYLVANIA
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

You can use the MODERN TWIST
Preformed GUY-GRIP* dead-end
GALVANIZED STEEL
Preformed GUY-GRIP* dead-end
COPPERWELD
Preformed GUY-GRIP* dead-end
BRONZE
*TRADE MARK
PATENTED—U.S. PATENT NUMBER 2,761,273
You can look up to Preformed™

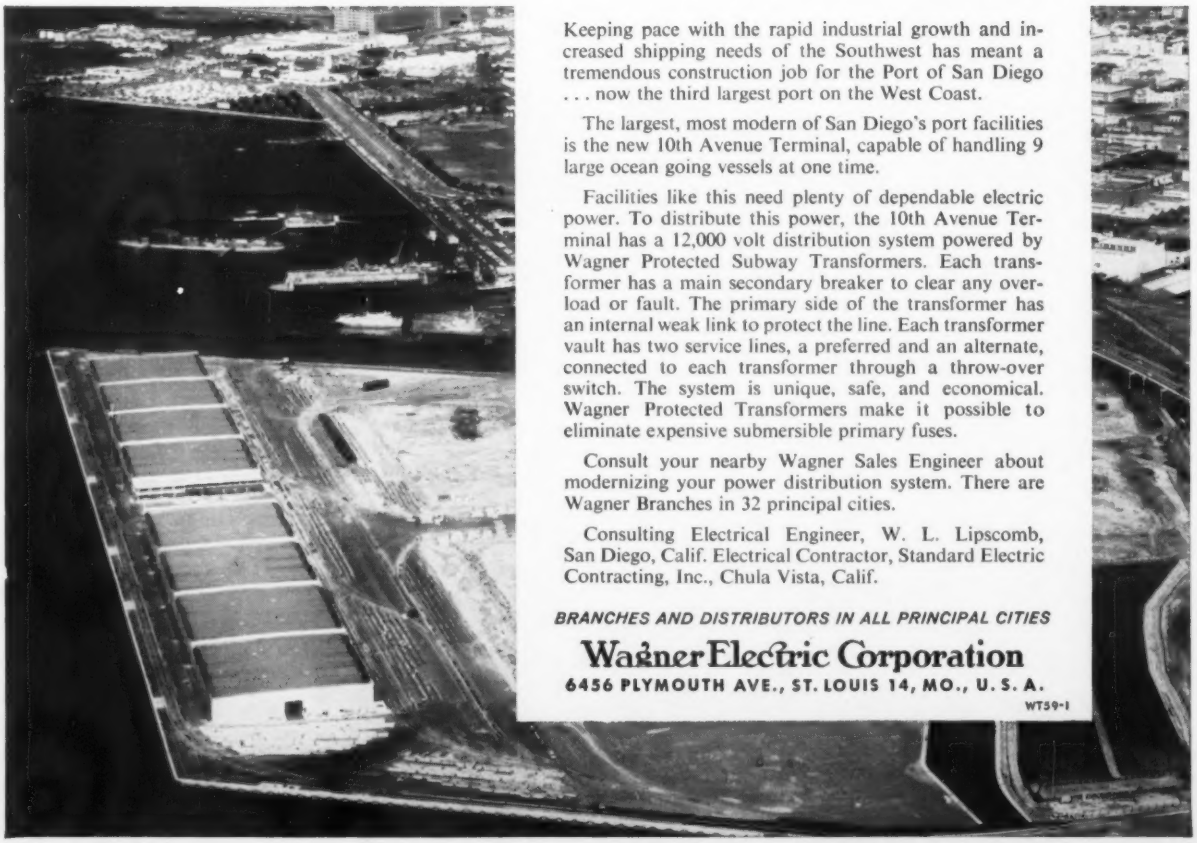
in GUYING...with all materials
Preformed GUY-GRIP dead-end
ALUMINIZED STEEL
Preformed GUY-GRIP dead-end
STAINLESS STEEL
Preformed GUY-GRIP dead-end
ALUMOWELD
Send for "THE GOOD GUY," plus APPLICATION PROCEDURES plus PRICE LIST
PREFORMED LINE PRODUCTS COMPANY
DEPT. GG 1
5349 St[illegible]air Avenue • Cleveland 3, Ohio

WAGNER PROTECTED TRANSFORMERS USED IN UNIQUE DISTRIBUTION SYSTEM:



Willis Lipscomb, Consulting Electrical Engineer, and Joachim E. Liebmann, Harbor Engineer, examine emergency overload feature on a 75 Kva, 3 phase Wagner Protected Transformer. The other Wagner Transformers are each 50 Kva, single phase.

POWER for the Port of San Diego



Keeping pace with the rapid industrial growth and increased shipping needs of the Southwest has meant a tremendous construction job for the Port of San Diego . . . now the third largest port on the West Coast.

The largest, most modern of San Diego's port facilities is the new 10th Avenue Terminal, capable of handling 9 large ocean going vessels at one time.

Facilities like this need plenty of dependable electric power. To distribute this power, the 10th Avenue Terminal has a 12,000 volt distribution system powered by Wagner Protected Subway Transformers. Each transformer has a main secondary breaker to clear any overload or fault. The primary side of the transformer has an internal weak link to protect the line. Each transformer vault has two service lines, a preferred and an alternate, connected to each transformer through a throw-over switch. The system is unique, safe, and economical. Wagner Protected Transformers make it possible to eliminate expensive submersible primary fuses.

Consult your nearby Wagner Sales Engineer about modernizing your power distribution system. There are Wagner Branches in 32 principal cities.

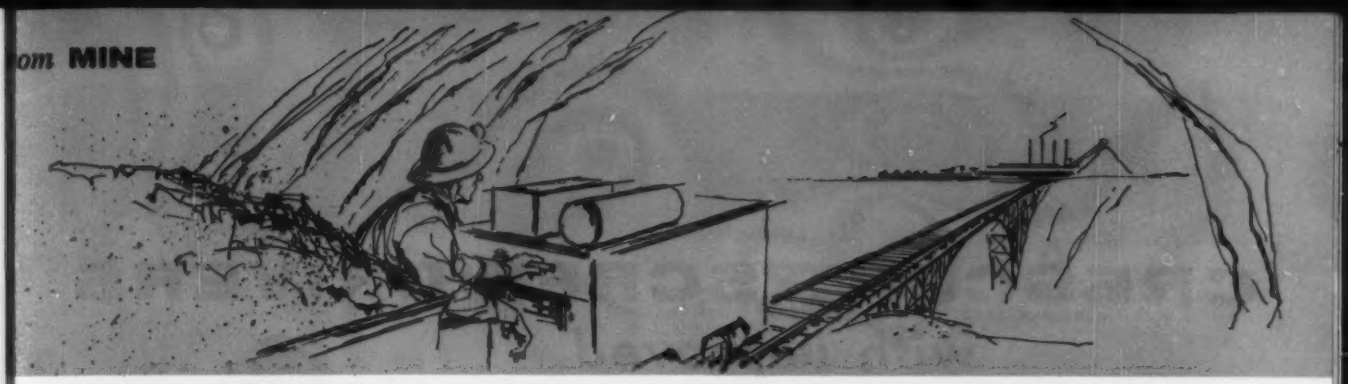
Consulting Electrical Engineer, W. L. Lipscomb, San Diego, Calif. Electrical Contractor, Standard Electric Contracting, Inc., Chula Vista, Calif.

BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

Wagner Electric Corporation

6456 PLYMOUTH AVE., ST. LOUIS 14, MO., U. S. A.

WT59-1



ONE SURE SOURCE OF SUPPLY

for all your wire and cable needs

Quality products, ample stocks, dependable deliveries—that's what you get when you work through a Circle distributor.

Quality products—because Circle controls every step in manufacturing—from the copper, lead, and zinc mined and refined by Cerro de Pasco down to the finished wire and cable—

Ample stocks—because Circle is one of the country's largest producers with over a billion feet of quality building wire and cable rolling out of its huge plants yearly—

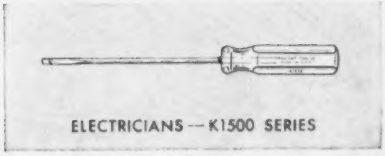
All-out service—because that's a basic policy at Circle, a policy which has earned Circle its reputation for giving fast, friendly, dependable service where and when it's needed.

Why don't *you* make a Circle distributor your "one sure source of supply." Many other satisfied contractors do.

CIRCLE WIRE & CABLE
a subsidiary of
CERRO DE PASCO CORPORATION

PLANTS: Maspeth and Hicksville, N. Y. SALES OFFICES & WAREHOUSES: in all principal cities

RUBBER COVERED WIRES & CABLES • VARNISHED CAMBRIC CABLES • PLASTIC INSULATED CABLES
NEOPRENE SHEATHED CABLES • "CIRTUBE" EMT



ELECTRICIANS — K1500 SERIES

CRESCENT SCREWDRIVERS

with improved Blue Tenite Handles

SQUARE ROD — K1600 SERIES

STUBBY
REGULAR & PHILLIPS POINT

Only in Crescent do you get this combination of handle and blade superiority. The improved Tenite handle provides a firm, comfortable grip that turns screws easily without causing hand blisters. The blade is hot forged, hardened full length, and then assembled to the handle under great pressure . . . it cannot turn loose or come apart.

EVERY CRESCENT SCREWDRIVER IS INDIVIDUALLY TESTED

Crescent tests each and every screwdriver to make sure that blades are hardened to exact specifications . . . your assurance that Crescent tips will not break or twist.

Crescent is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK

Traffic Cops that never sleep...

VICTOR Apparatus Insulators

Sub-station switches are comparable to traffic cops. They are designed to keep power (traffic) moving from generating stations to consumers without interruption or confusion. Their ability to perform the necessary switching operations, instantly, reliably, is dependent on apparatus insulators used in their assembly.

VICTOR No. 729
Apparatus Insulator
(EEI-NEMA 58-7)

"THE PEOPLE'S CHOICE"

VICTOR Apparatus Insulators are the universal choice of power men . . . for several very important reasons. Proven design, quality controlled manufacture and conscientious testing have given them an enviable reputation for reliability under extreme conditions of service. These insulators have mechanical and electrical test values far above EEI-NEMA standards. They are premium grade insulators, designed and made to do the job better, longer, more dependably than any other apparatus insulator made. You just can't buy better stacking units—at *any* price!

WELL PUT TOGETHER

Yes sir! When you put VICTOR Apparatus Insulators in your sub-station, you've got insulators that won't let go even under rigorous switching service. Made of Purified Porcelain, scientifically fitted with highest quality glaze, the shells together with cap and pin are assembled with premium grade insulator cement in tempered cast-iron jigs. VICTOR Apparatus units are not only put together right . . . they *stay* put together. And their jig assembly results in completely accurate alignment for easy, speedy stacking.

BLACK LIGHT

Soundness of insulator porcelain is of utmost importance to every power man. Imperfections, too small for detection by eye alone, can cause costly failure and interruption of service. We certify the soundness of our larger shells by the use of black light. Before glazing we spray them with a fluorescent material, then bathe them in ultra-violet light. This process detects the slightest imperfection. Shells found imperfect are discarded. This procedure assures you of perfect insulators, cuts costs, minimizes replacements, safeguards service.

WE MAKE OUR OWN RAIN

One of the big advantages of choosing a VICTOR insulator is the knowledge that the EEI-NEMA ratings published in the VICTOR catalog are minimum. Fact is, every VICTOR unit has an in-built reserve that permits it to operate at or above these ratings. We know it because our laboratory tests have proved it. Take wet flashover, for example. We subject our insulators to artificial rain sprayed through a scientifically designed nozzle while 60-cycle current is applied in gradually increased voltage steps until flashover occurs. Water is of controlled resistivity, volume and direction. This is why you get wet weather protection "above and beyond the call of duty" —with VICTOR.

LIGHTNING . . . MADE TO ORDER

In order to really know how an insulator will withstand the effects of lightning, we make our own. VICTOR's electrical laboratory is equipped with an impulse generator that throws a lightning bolt at an insulator under test. This modern unit is equipped with a remote controlled gap spacing mechanism, an oscilloscope for showing wave forms visibly on the screen of a cathode ray tube and a 4" x 5" camera for recording these waves on film for observation and study. One more reason why VICTOR gives you insulators that last . . . that are design-tested to withstand lightning and other adverse service conditions.

For full information on VICTOR Apparatus Insulators write I-T-E Circuit Breaker Company, Victor Insulators Division, Victor, N.Y.

I-T-E CIRCUIT BREAKER COMPANY

VICTOR INSULATORS DIVISION

Now you get 2 important new features on G-E

FULL-VALUE
CERTIFIED
TRANSFORMER
GENERAL ELECTRIC

- Superior design, features, and performance
- Faster shipment
- Complete service

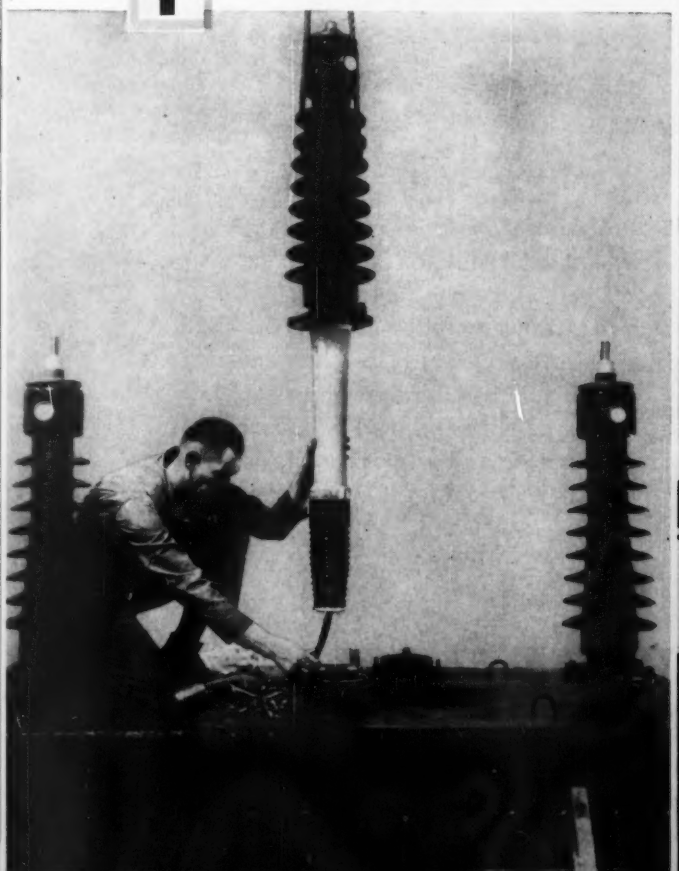
Here's how General Electric has solved two long-standing industry problems. Now, General Electric offers standard bushings interchangeable between medium* transformers and circuit breakers—4 standard designs where 24 previously were needed—that meet American Standards for bushings. General Electric also makes available a direct-acting mechanical pressure-relief device which gives tank protection from excessive internal pressures at all times. Both of these new features are now standard on all G-E medium transformers. Here is what each of these new features means to you . . .

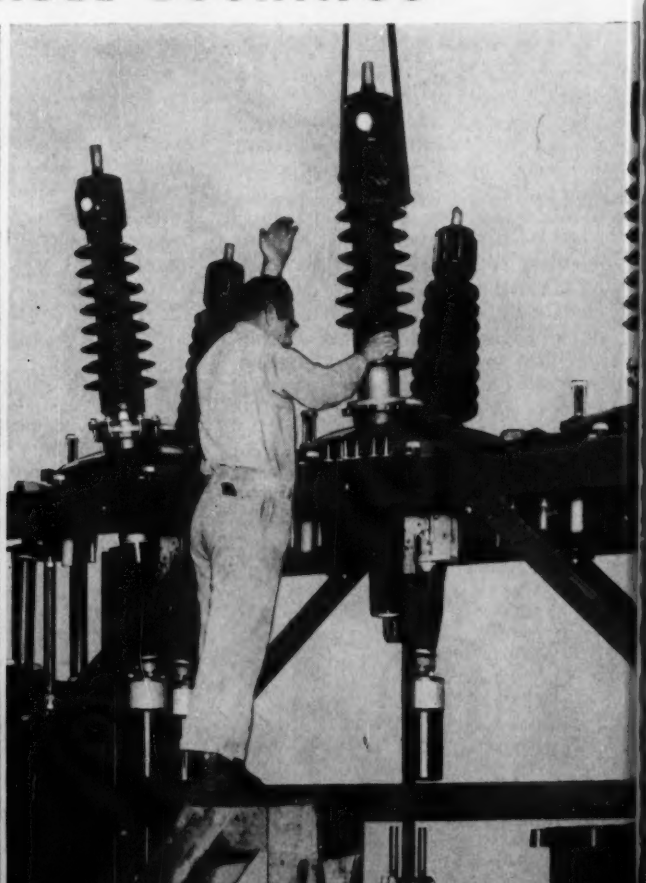
INTERCHANGEABLE BUSHINGS. In addition to inventory reduction, these bushings permit conversion from draw-lead transformer application to bottom-connected breaker application by changing only the top terminal hardware. These General Electric Type U bushings include such features as lined-tapered core, completely oil-filled, oil-level indication, power-factor test tap, and center-clamped construction. Four basic designs are completely interchangeable between medium transformers and circuit breakers in 400- and 1200-ampere ratings, 25 through 69 kv.

NEW PRESSURE-RELIEF DEVICE. Diaphragmless, shockproof, corrosion-resistant throughout, self-reclosing, and self-resetting are characteristics of the new G-E design. This simple, rugged device, made

* 501 to 7500 kva, 69 kv and below.

1 INTERCHANGEABLE BUSHINGS





G-E medium transformers

of aluminum castings and stainless steel machined parts, is designed to eliminate breakage, thereby preventing fragments from falling into the transformer.

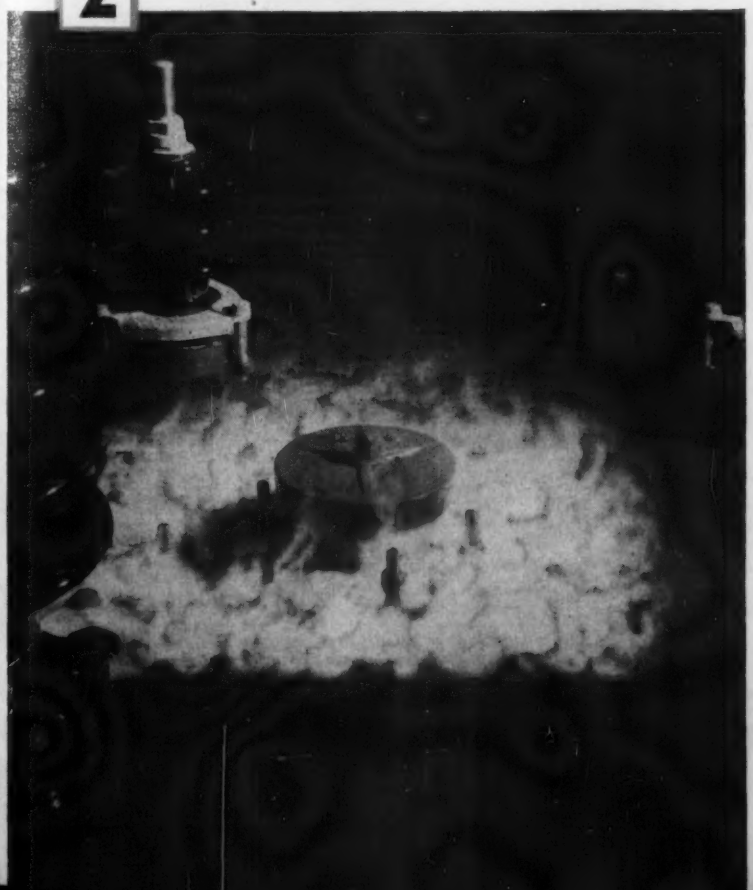
Product leadership is just one part of our story. General Electric medium transformers are certified to deliver **full value** for your transformer dollar . . . in terms of superior products . . . plus faster order handling and shipment . . . plus complete service before, during, and after installation. When deciding on your next medium transformer, examine the **complete "package"** offered by General Electric. When you do, we're confident you'll recognize G-E superiority and how you get full value for your transformer dollar.

For full information and application help on Certified Full-value medium transformers, see your G-E Apparatus Sales Engineer. General Electric Co., Schenectady 5, N. Y. 416-23

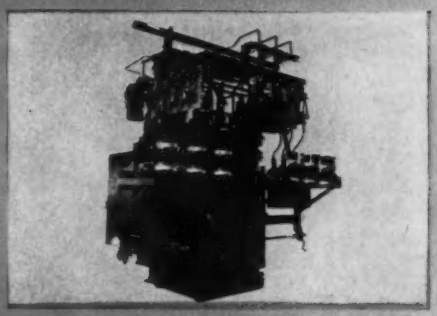
Progress Is Our Most Important Product

GENERAL ELECTRIC

2 PRESSURE-RELIEF DEVICE



FULL VALUE FOR YOUR TRANSFORMER DOLLAR



SUPERIOR DESIGN, FEATURES, AND PERFORMANCE of General Electric transformers is typified by pre-fabricated enclosure (above) and super-compact substation with medium transformer (below).

FASTER SHIPMENT through rapid processing of orders . . . computer design capability . . . repetitive manufacturing facilities.

COMPLETE SERVICE . . . application and systems engineers . . . installation engineers . . . 50 conveniently located service shops.

. . . made more useful

by MACALLEN

Unfailing stability at high operating temperatures is often the key requirement of MACALLEN Mica . . . in products ranging from toasters to diesel-electric locomotives. With MACALLEN Mica this vital insulating property can be applied in the widest range of shapes and sizes . . . with the greatest efficiency and economy. Solve *your* insulation problem with MACALLEN Mica . . . choice of the electrical industry since 1892. Send for free Catalog 25 today.

MACALLEN MICA

• ALL FORMS • ALL QUANTITIES
• ALL DEPENDABLE

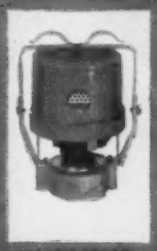
THE MACALLEN COMPANY, INC.

Bay Road, Newmarket, New Hampshire

CHICAGO: 565 W. Washington Blvd.
CLEVELAND: 1231 Superior Ave.

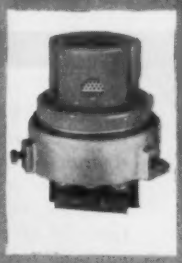
DEPENDABLE
FISHER-PIERCE
EQUIPMENT
...for outdoor lighting control

Model 6601A
Pole or
crossarm mounting



Model 6603A
Replacement plug-in
for FP Model 64400GE

Model 6602A
Luminaire or
slipfitter mounting
(1¼" top tap)



Model 6607A
with pole top
adapter

Model 6604A
Replacement
plug-in for
FP Model
S-64400

Model 6600A ACTUAL SIZE

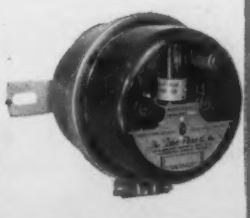
NEW SERIES 6600A PHOTOELECTRIC CONTROLS —
tubeless, field-tested, low-cost.

Rugged, reliable control fully tested in the field for five years; guaranteed for two years. Uses hermetically sealed cadmium sulfide photocell driving a specially-designed Sigma relay. Lightweight, measures only 2¾" high x 3⅛" in diameter, easy to install. Three prong twistlock plug and removable sponge gasket conform with EEI-NEMA specifications for twistlock adaptations. Features include built-in lightning protection; delayed response to prevent accidental turn-off by lightning; fail-safe operation; and adjustable turn-on. Switches 1000 watts, operates on 105-135v, 50/60 cycle AC; standard turn-on 1.5 ± 0.5 foot-candles. Temperature range –55° to +70°C; humidity tested to 100%.

Model 6600A (shown actual size) is the basic model in the series, fits bases up to 3" in diameter; *Model 6607A* fits wider mounting bases, up to 3⅛" in diameter. Both may be used with various Westinghouse, GE, Wheeler, Joslyn and other popular luminaires. With standard adapters and mounting hardware (see Models 6601A, 6602A, 6603A, and 6604A), 6600A Series controls meet a wide variety of mounting requirements.

SERIES 63300C PHOTOELECTRIC CONTROL —
switching capacity up to 6000 watts; turn-on 1 to 1000 foot-candles.

Electronic head enclosure is waterproof; plugs directly into meter socket... standard switching arrangements SPST, SPDT, DPST... fail safe operation... delayed circuit response to prevent false operation due to lightning... fuse and potentiometer checked or adjusted without removing enclosure... for 105-130 or 210-250 volt, 50/60 cycle operation; insulation level 4.5 KV.



FISHER PIERCE
PHOTOELECTRIC LIGHTING CONTROLS
AN AFFILIATE OF SIGMA INSTRUMENTS, INC.

For descriptive bulletins on any of this equipment write to
The Fisher-Pierce Co., 82 Pearl St., So. Braintree 85, Mass.

SERIES 6100 CALIBRATOR

... for checking and adjusting turn-on and turn-off points of nearly all types of photoelectric lighting controls. Easy to use... accurate... portable. Assures uniform turn-on settings, better control of burning hour schedules, thorough testing of units before installation; useful for trouble-shooting. Operates on 117 volts, 50/60 cycles AC; special adapter available for 220 volt operation.

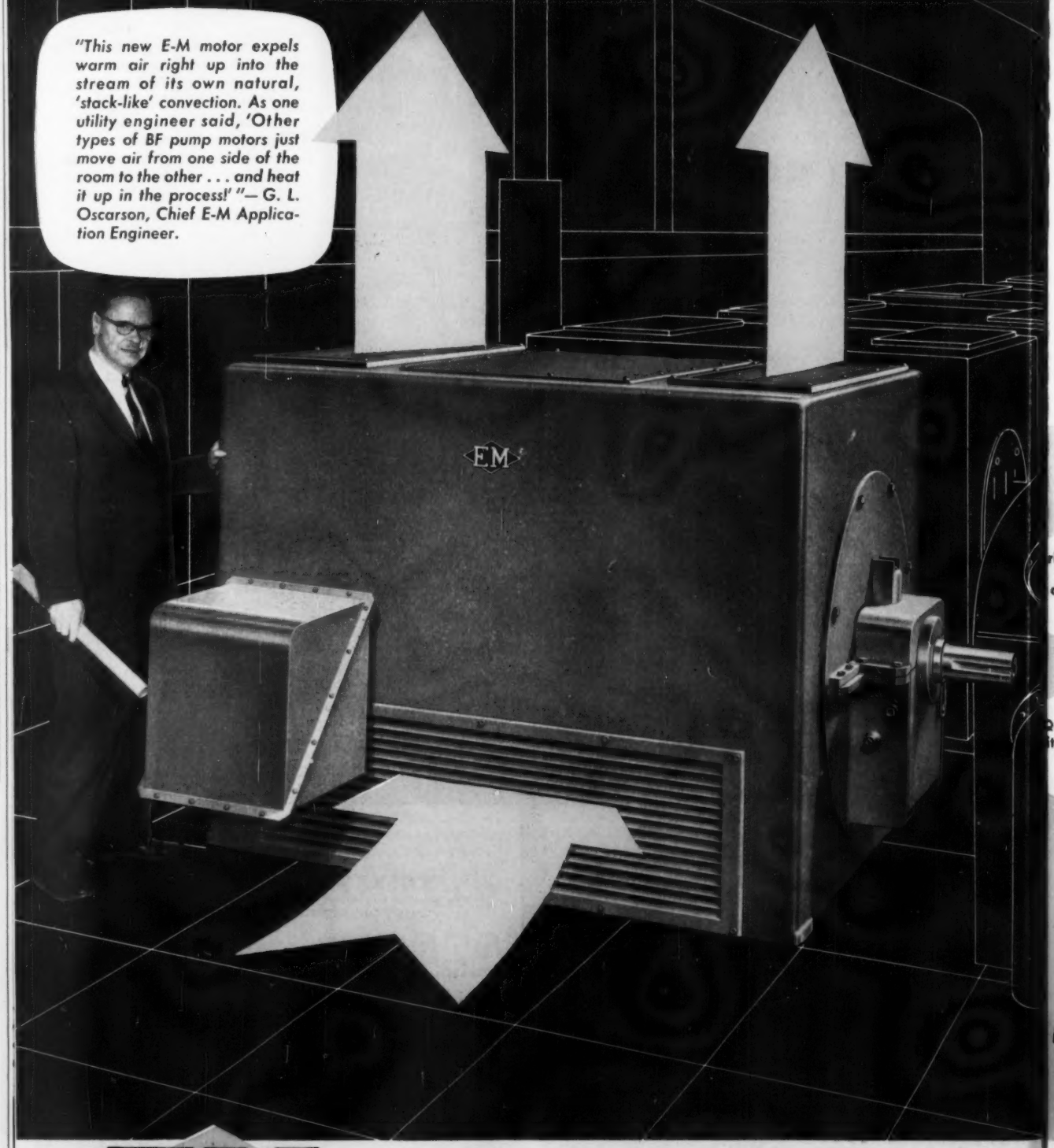
TYPE 250A MULTIPLE RELAY

... for pilot wire control, cascading street lighting circuits, or industrial applications. Weatherproof, dependable, low-cost. Normally-open or normally-closed contacts; 30-ampere rating with maximum inrush of 300 amperes; 3000 watt lamp load; 105-130 volt, 50/60 cycle operation. Equipped with built-in expulsion-type lightning arrestor.

Power plant engineers asked for it!

New Straight-Up-Ventilated

"This new E-M motor expels warm air right up into the stream of its own natural, 'stack-like' convection. As one utility engineer said, 'Other types of BF pump motors just move air from one side of the room to the other . . . and heat it up in the process!' "— G. L. Oscarson, Chief E-M Application Engineer.



E-M

1500-TPA-2197

ELECTRIC MACHINERY

Builders of the new pump motor

E-M *designed it! Here it is! The...*

Boiler Feed Pump Motor

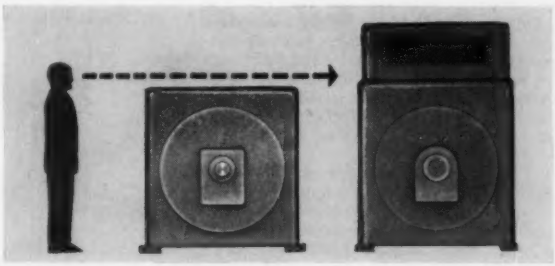
Blows warm air straight up and away!

It has FOUR GREAT NEW FEATURES you've always wanted:

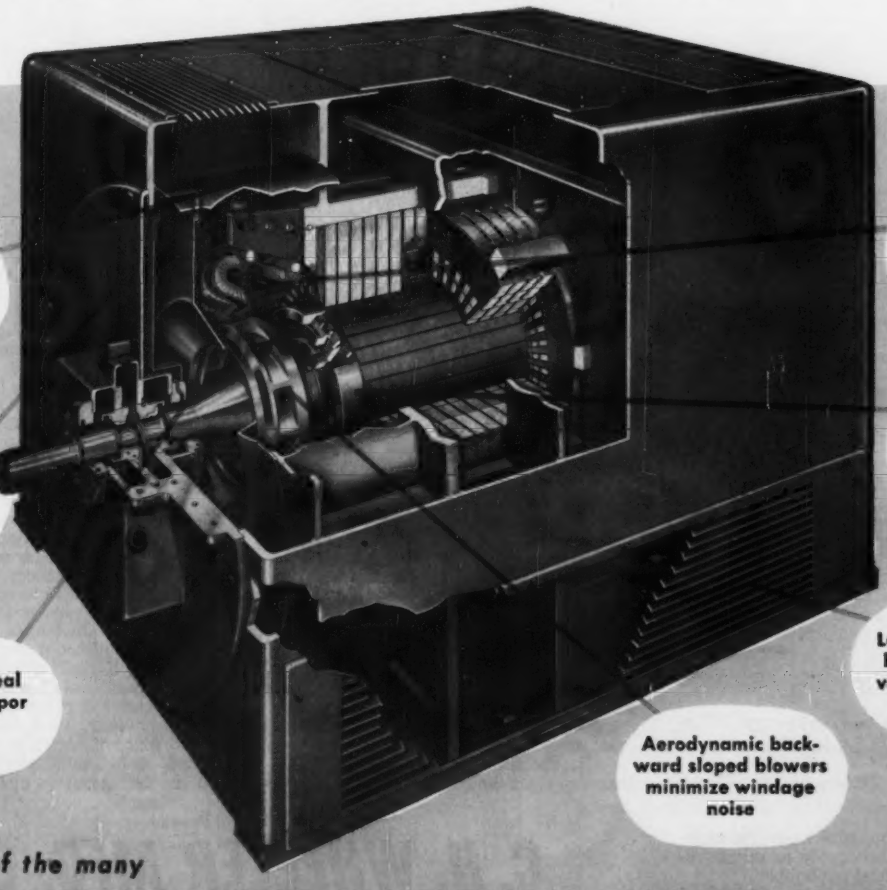
1. NEW TOP DISCHARGE. The new E-M motor ejects ventilating air straight up from the top. The heated discharge air rises straight to the ceiling.

2. COOLER INTAKE AIR. Split-level inlet-outlet prevents cross circulation and recirculation, permits close motor spacing.

3. GREATER OPERATOR COMFORT. No more "face blasting". The new E-M Motor eliminates warm air build-up at operator level, makes work more comfortable.



4. BETTER VIEW OF PUMP ROOM. View-blocking superstructures are gone. The new E-M design is low, modern, compact.


ripproof protection; falling particles can't enter motor working parts
Quick, easy access ith light, functional plates
Air pressure seal prevents oil vapor seepage
Triple anchored coils for coil-end stability
"Locked-in" factory balance provided by cage end-ring retainer
Large vents permit high volume, low velocity ventilation
Aerodynamic backward sloped blowers minimize windage noise

Learn more of the many

BIG DIFFERENCES THAT MAKE THE DIFFERENCE

Find out all about the motor that's "nice to be near." Call your nearby E-M Sales Engineer. Write today for Straight-Up-Ventilated Motor brochure, No. 1134W

Y MFG. COMPANY MINNEAPOLIS 13, MINNESOTA

tor that performs as well on the job as on the test stand

How C. H. Wheeler condenser design provides optimum deaeration and REDUCES STATION MAINTENANCE

An informative advertisement from one of the nation's most experienced condenser manufacturers

The problem of power plant steam system maintenance involves many things including cleaning the water and steam sides of condenser tubes, tube damage caused by impact of water in exhaust steam, tube abrasion resulting from sand or grit in the circulating water, tube plugging resulting from foreign matter in the circulating water, and deposits in the boiler.

One of the most important ways to reduce station maintenance requirements is to improve deaeration. Excess air in condensate results in corrosive oxide deposits in the boiler which decrease its efficiency. During 56 years of condenser design and manufacturing, C.H. Wheeler has developed a number of ways to produce deaerated condensate *in the condenser*. In special designs, they maintain oxygen content of less than 0.01 cc. per liter. Oxygen levels of far less than 0.01 per liter are often achieved in C.H. Wheeler Condensers, depending upon the amount of air leakage of the system and the amount of contaminated returns.

Basic causes of oxygen and other non-condensable vapors in condensate are system leaks, heater returns and make-up water.

Full deaeration of make-up water requires bringing it up to the temperature of the steam, so that the condensate is 100% saturated with water vapor and all gases have been driven from solution. However, to be sure that no gases are mechanically entrained in the droplets of water, the water must be agitated thoroughly to permit release of any remaining air bubbles.

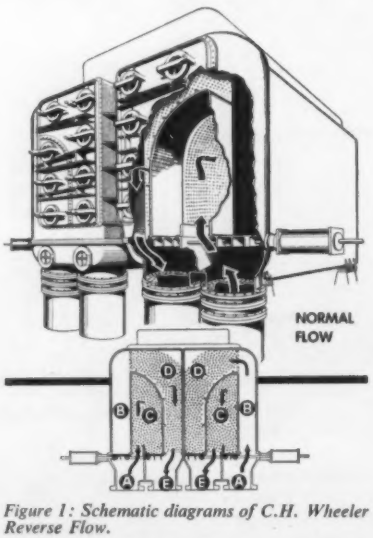


Figure 1: Schematic diagrams of C.H. Wheeler Reverse Flow.

In C.H. Wheeler Condensers, normal make-up water is heated to steam temperature and agitated to release non-condensables by spraying it over the top of the tube banks at both ends of the tubes, and out of the path of high-velocity steam from the turbine exhaust. Steel bars above the tubes protect them from water impingement damage. Heater drips are sprayed in the steam lanes to permit flashing and release of entrained gases.

Condensate is cascaded over deaerating bars (1, in Figure 2) in the presence of a moving blanket of steam, to provide proper agitation and reheating before it is drained into the hotwell. The Tubejet® Air Ejector (3) draws off non-condensable gases through the air-vapor suction line (2), and discharges them to the atmosphere. Central location of the air cooler section reduces depth of steam penetration and resistance to steam passage, achieving a new low in condenser pressure loss.

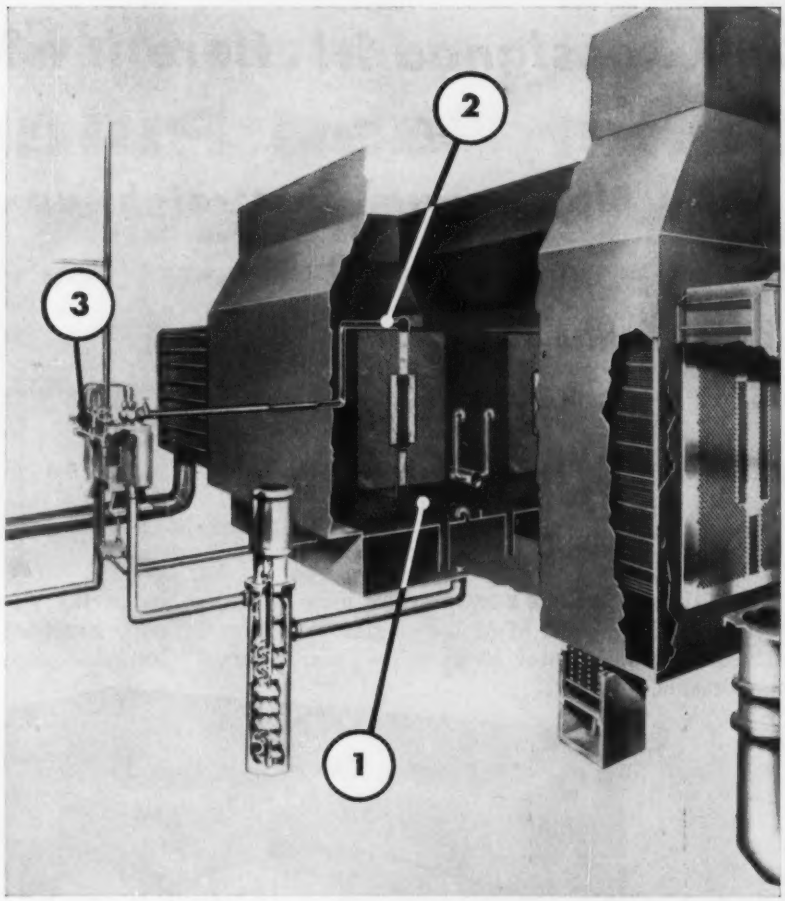


Figure 2: Cutaway drawing of portion of C.H. Wheeler Dual Bank, Divided Water Box Condenser.

Another Big Problem—Tube Cleaning

If your water supply is polluted, condenser tube deposits may become troublesome. There are several ways to correct this situation: Shooting small slugs through the tubes with high-pressure water, using acid and chlorinating the circulating water, among other methods.

One method particularly successful in removing algae, and foreign matter such as twigs, leaves and scale, is Reverse Flow (see Figure 1). Developed by C.H. Wheeler, it makes possible the flushing of tubes and sheets without shutting down the condenser.

Here's how Reverse Flow works: Normal operation is shown on the left. Water enters through inlet A with right inside port open, flows through tube bank C to the rear of the condenser. It returns through tube bank D to the front of the condenser, and then it discharges at E.

The right side of the diagram shows Reverse Flow in operation in a C.H. Wheeler Dual Bank, Divided Water Box Condenser. Water enters through A with outside port open, flows up through channel B and through tube bank D to rear of condenser, returns through tube bank C to front of condenser and discharges at E. Reversing can be accomplished during full load operation and full flow of circulating water, without additional pressure loss. Sluice gates for each half of the condenser move on a common stem. Each half can be back-flushed independently; or both halves can be back-flushed simultaneously with one or two circulating pumps operating.

C. H. WHEELER MFG. CO.

19th and Lehigh Avenue • Philadelphia 32, Pennsylvania

Whenever you see the name C.H. Wheeler on a product, you know it's a quality product.

Steam Condensers • Steam Jet Vacuum Equipment • Centrifugal, Axial and Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Components

• Southwire Galvanized Steel Strand

STRAND SIZE	5/8"	1/2"	7/16"	3/8"	5/16"	9/32"	1/4"	3/16"
WEIGHT PER 1000'	813 lb.	517 lb.	399 lb.	273 lb.	205 lb.	164 lb.	121 lb.	72.9 lb.
MINIMUM BREAKING STRENGTH IN POUNDS								
ASTM A-122-54T								
Galvanized (Single Galv.) Common	11600	7400	5700	4250	3200		1900	1150
Class A (Double Galv.) Common	11600	7400	5700	4250	3200		1900	1150
Class A (Double Galv.) Siemens-Martin	19100	12100	9350	6950	5350	4250	3150	1900
Class A (Double Galv.) High Strength	29600	18800	14500	10800	8000	6400	4750	2850
Class A (Double Galv.) Extra High-Strength		26900	20800	15400	11200	8950	6650	3990
Class A Utilities Grade, A.T.&T. and Western Union Spec.—7-wires		25000	18000	11500	6000*	4600		2400**
ASTM A-363-55T (No welds)								
Weldless High-Strength		18800	14500	10800	8000			
Weldless Extra High Strength		26900	20800	15400	11200			

*weight per 1000'—225 lbs. **weight per 1000'—80.3 lbs.

The infinite patience and skill used by the seafarer in stranding or splicing rope is matched by modern machines at Southwire.

Southwire Galvanized Steel Strand is manufactured to meet or exceed applicable ASTM specifications . . . and preformed to eliminate flared ends when sheared. Quality is our first concern, including premium-quality non-returnable reels on all reel shipments. Available in 250', *500' and 1,000' coils, 2,500', *5,000', 5,280' reels. Feel free to inquire about special packaging to suit your particular requirements.

Specify Southwire Galvanized Steel Strand for ground, messenger and guying applications, *shipped by our own fast fleet of trucks direct to your warehouse or jobsite.*

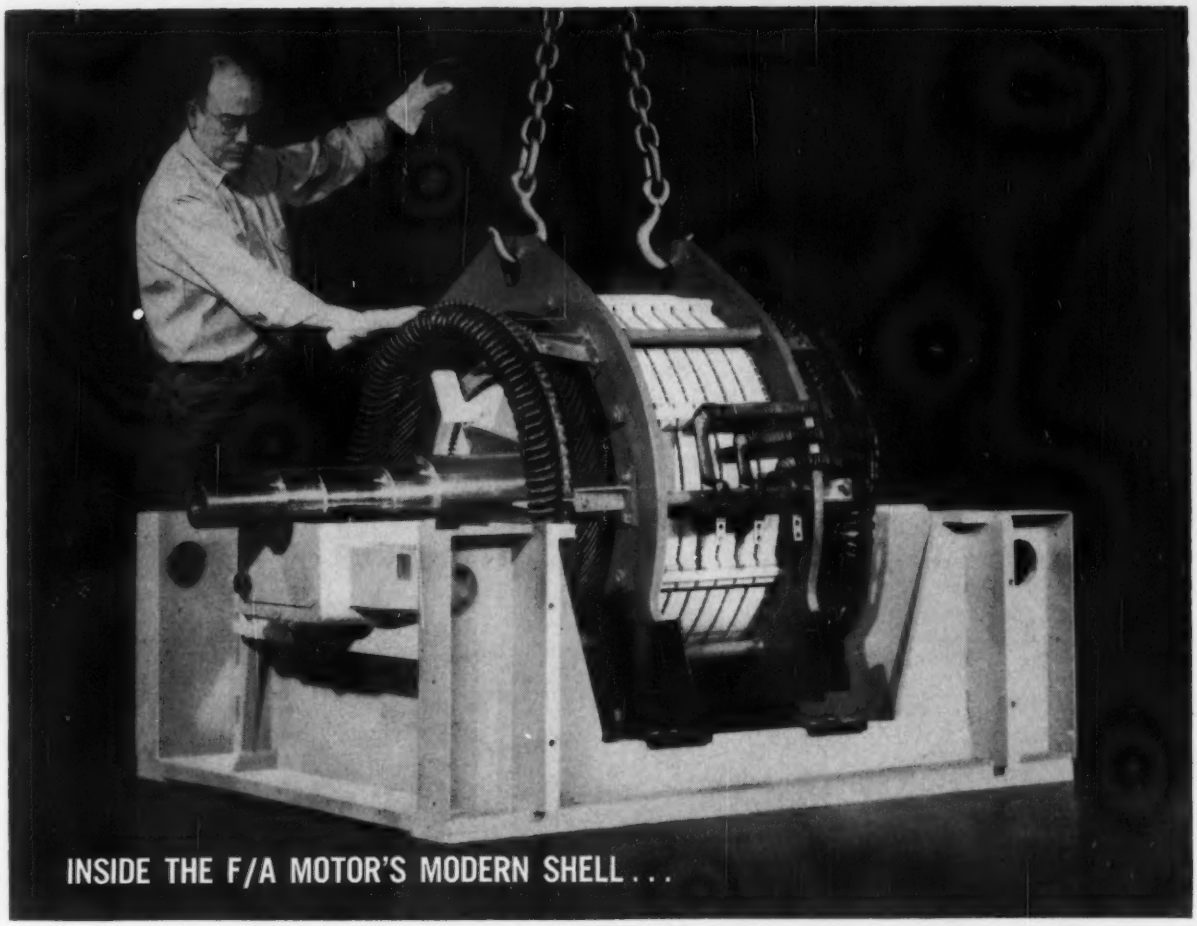
*Stock items

Southwire Company

Carrollton, Georgia—TErrace 2-6311

- Bare and Weatherproof Copper and Aluminum Line Wire
- Neoprene, Polyethylene, and VWP (Vinyl) Weatherproof Copper, Aluminum and Triplex
- U.R.C. (DBWP, TBWP) Copper
- Copperweld® Conductors
- Copper and Aluminum Building Wire
- ACSR and All Aluminum Cable
- Galvanized Steel Guy Strand and Static Wire
- Aluminized Steel Guy Strand and Static Wire
- Aluminum Alloy Wire
- Cable Accessories
- NM Sheathed Cable

• ALSO FABRICATORS OF COPPER AND ALUMINUM FOR WIRE AND CABLE MANUFACTURERS



long life, lowest maintenance, backed by 7000 success stories

WEATHER-TESTED FOR OVER TWO YEARS...WITH NO MAINTENANCE!

This conventional indoor, 600-hp motor with Thermalastic insulation has been running outdoors for more than two years. Built before the F/A Motor was introduced, it has been subjected to these rigorous conditions:

- Twenty-four hours a day, five days a week, with weekend shutdowns to produce stopping and starting surges
- Summer and winter, all weather and temperature extremes
- Two-week shutdown during which it was sprayed almost continuously with fire hoses

It is still running smoothly and shows no signs of insulation breakdown or other deterioration.

In 7000 large-motor installations and over 15 million horsepower of Westinghouse large rotating apparatus, not a single breakdown occurred from Thermalastic® insulation failure.

One reason for this amazing service record lies in the unique molecular structure of Thermalastic insulation. Large, overlapping mica splittings are locked in a void-free, memory-type elastic bond, forming a perfect dielectric barrier which is maintained under *all* operating conditions.

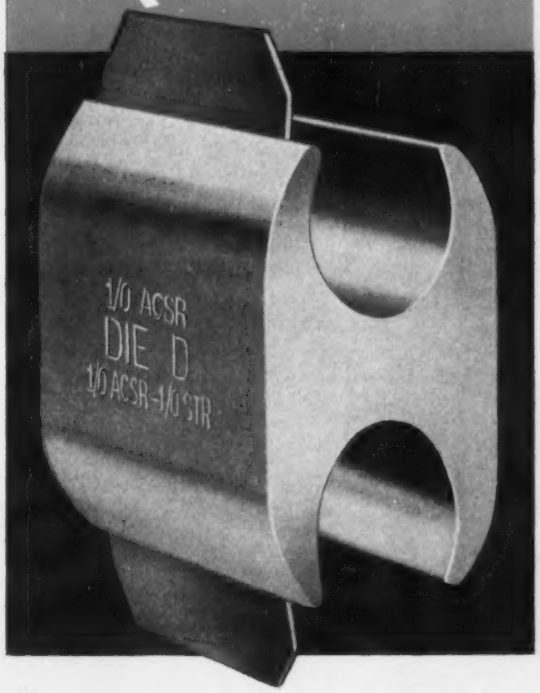
Because of Thermalastic, your F/A Motor serves you longer and better. This insulation system withstands prolonged voltages, abrasion, corona arcing and frequent-starting surges. F/A Motor applications are virtually unlimited because Thermalastic is chemically stable, will not react, dissolve, crystallize or evaporate in contact with acids, alkalis, oils, lamp black, dirt, moisture or temperature extremes.

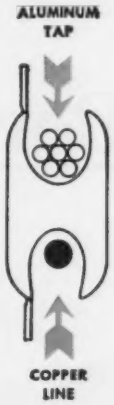
Consider what these proved performance extras can mean in down time and maintenance savings alone. For more specific test data, call your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. J-15013

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

new! KEARNEY DOUBLE-TAB SQUEEZON



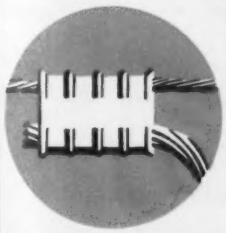


Exclusive Kearney design permits either groove to be used for line or tap. Diagram illustrates Double Tab Squeezon used to make an aluminum "step-up" tap to copper line connection.

NOW! The Easiest Way to Make Both "Step-Up" and "Step-Down" Tap Connections on All Combinations of Copper, Aluminum and ACSR

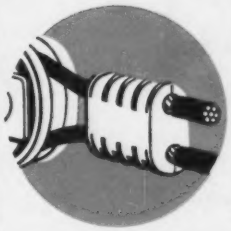
The newest, most versatile Squeezon Compression Connector. Dual, fully open groove design, exclusive with Kearney, eliminates need to thread tap conductor through fitting. Use *either* groove for line or tap . . . make "step-up" or "step-down" tap connections quickly and easily. Double Tab Squeezons speed up deadending, too. Form the loop . . . drop the conductors into the open grooves . . . and compress! On insulated wire, remove only a "Squeezon-length" of insulation!

Available in a range of size combinations for aluminum, copper or ACSR. (Write for Selector Card.) Individually packaged in handy "Snap-Open" boxes; grooves factory-filled with Kearnalex inhibitor and contact aid.



REVERSIBLE
The only compression connector with built-in spacer that makes *BOTH* "step-up" and "step-down" tap connections, from copper to ACSR, aluminum to ACSR, or aluminum to copper.

MASSIVE SPACER
Separates conductors . . . eliminates strand cutting . . . and aids in the prevention of galvanic corrosion between dissimilar conductors.



SECONDARY DEADENDING
Faster, easier. No threading through . . . form the loop, position Squeezon and compress! On insulated wire, strip only enough insulation to make the connection.

"SNAP-OPEN" BOX
Individually packaged. Box snaps apart along perforated line . . . INSTANTLY, CLEANLY . . . even with gloves! No stripping, no peeling.

NO DISTORTION
Squeezon groove jaws completely encircle conductor when compressed . . . provide dependable long-line, full circumference contact without distortion or damage to conductor.

for better construction . . . safer maintenance . . . specify KEARNEY products

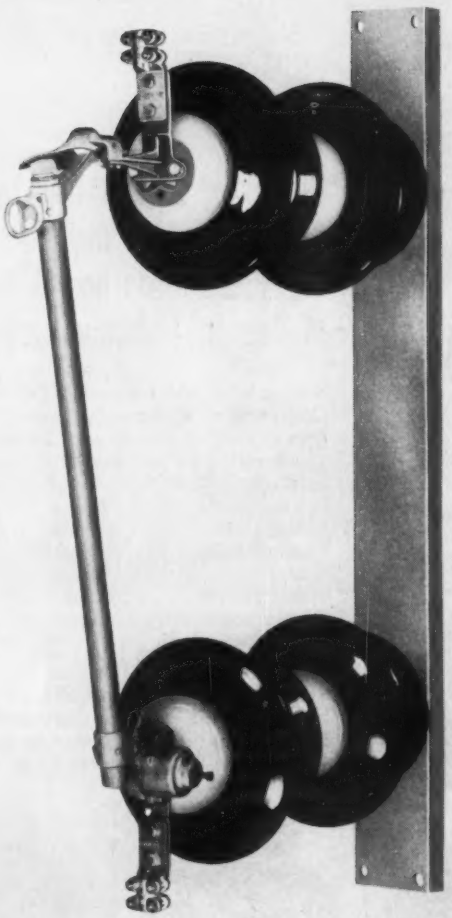
JAMES R. KEARNEY CORPORATION ST. LOUIS, MO.

JAMES R. KEARNEY CORPORATION

4224-42 Clayton Avenue, St. Louis 10, Missouri

PLANTS AT: ST. LOUIS • FAYETTEVILLE, ARKANSAS • SHENANDOAH & CLARINDA, IOWA • GUELPH, ONTARIO, CANADA

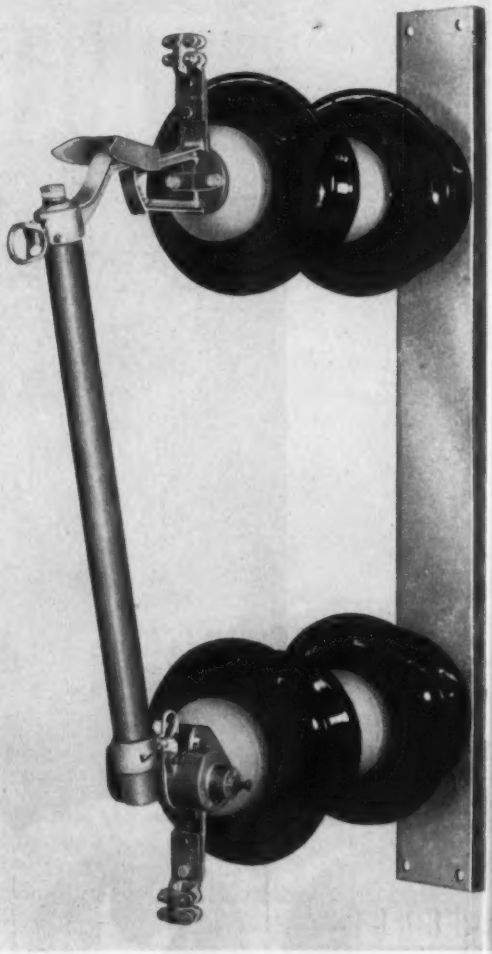
A Powerful New Family of Po



TYPE BP

7.5 kv to 69 kv—100 and 200 amps

This heavy duty power fuse is ideally suited for economical system protection when interrupting capacities range no higher than 1,491,000 kva.



TYPE MP

46 kv to 161 kv—100 and 200 amps

This extra heavy duty power fuse is the huskiest of the Southern States line, with interrupting ratings as high as 3,480,000 kva. A real brute!

7.5 kv to

This extra
suited for
bination o
nterruptin

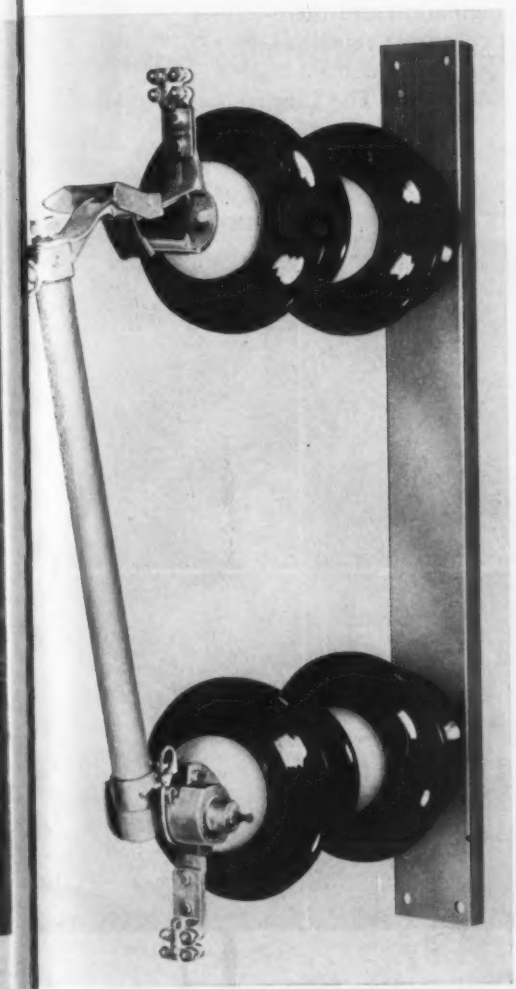
PIONEERS IN POWER FUSES SINCE 1924

SOUTHERN STATES EQUIPMENT CORP.

HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto

Power Fuses by Southern States



TYPE HP

7.5 kv to 69 kv—300 and 400 amps

This extra heavy duty fuse is especially suited for applications requiring a combination of high continuous current and interrupting ratings.

COMPLETE FUSE KITS AVAILABLE

These economical kits, in clearly marked packages, provide field personnel with *all the components necessary* for quick, easy re-fusing. They are available in four speed ratios to meet all requirements. Contents are sealed in moisture-free polyethylene bags.

- **HIGHEST INTERRUPTING RATINGS**
  Up to 785,000 kva at 23 kv—2,350,000 at 69 kv—3,480,000 at 161 kv
- **LOWEST INITIAL AND RE-FUSING COSTS**
- **WIDEST RANGE OF SELECTIONS**

Here is the greatest development in power fuses in years! It comes at a time when higher system faults and complex load conditions call for greater reliability in system protective devices.

Southern States Power Fuses can be used with full assurance of positive interruption in the complete range of fault currents—from the lowest that will melt the current-responsive element to the worst jolt the system can deliver!

The fuses employ a new fuse holder design and rugged fibreglass* fuse tubes to clear faults at values never before thought possible.

For example, look at these representative ratings:

TYPE	KV	KVA 3 phase symmetrical
BP	7.5	162,000
BP	15	406,000
BP	23	785,000
BP	34.5	1,175,000
MP	46	1,988,000
MP	69	2,350,000
MP	115	3,110,000
MP	138	2,980,000
MP	161	3,480,000

Find out how these new Southern States Power Fuses can be used on your system—to provide greater protection at lower cost. See your Southern States representative, or

WRITE FOR NEW TECHNICAL BULLETIN 59PF

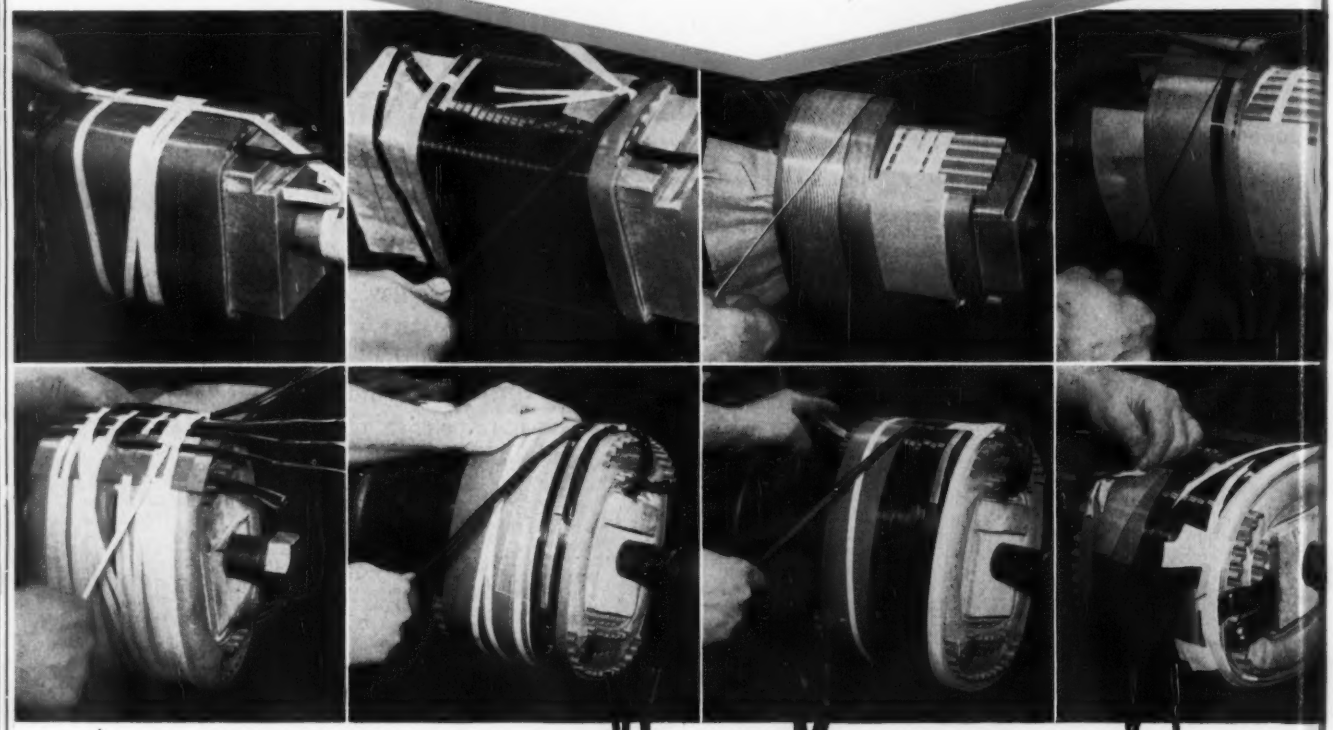
SOUTHERN STATES EQUIPMENT CORP.
HAMPTON, GEORGIA

**For economy and where duty requirements are not excessively high, fuse tubes of NEMA grade XX bakelite are available below 46 kv at lower prices.*

MOLONEY DISTRIBUTION TRANSFORMER COILS . . . DESIGNED FOR PERFORMANCE

The coils used in Moloney Distribution Transformers are composed of materials especially selected and carefully tested for this specific application. These materials, used under the supervision of experienced transformer design engineers, result in a mechanically-strong, electrically-efficient coil. One feature of this coil is the low impedance which results in improved voltage regulation and therefore increased revenue and better customer relations. Specify the transformers designed for performance . . . Specify Moloney Transformers . . . All Along The Line.

MEDD-3



Turns anchored in place.

HV winding sectionalized to reduce layer stresses.

Thermo-setting resin-coated paper used between layers.

All leads vinyl covered where they are brought through the coil.

Cooling ducts strategically located.

LV-HV-LV sequence of coils gives optimum clearance from HV to ground.

Extra insulation on coil leads, connections and taps.

MOLONEY ELECTRIC COMPANY

Manufacturers of Transformers for Utilities, Industry, and Electronic Applications

SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES AT ST. LOUIS 20, MO., AND

Editorial Comment

MAY 18, 1959

Memo to Utility Management—Check Your Safety Program

We find ourselves nodding in agreement with comments in a recent letter that REA Administrator David Hamil sent to managers and directors of the agency's 1,600 borrowers urging them to make safety a priority program.

Calling attention to the "deplorable record" of 30 employee fatalities on electric systems during 1958, the highest number suffered by REA borrowers since 1949, he said this:

"Studies of accidents on borrower systems indicate that the cause of far too many can be traced to indifference to safety on the part of management."

The REA Administrator urged directors to review current safety programs and to make sure that management is exercising "appropriate direction and control."

Hamil's observation on the cause of accidents bears repeating in every utility industry staff meeting. This month, as the construction season gets into full swing, safety programs should come up for critical review.

Safety is everybody's job and it is a responsibility that extends across organization lines and throughout the industry. But if there is any particular group that has the capacity and the responsibility to make safety work—to make it more than just poster program—that group is management.

Too often today, management is failing to exercise "appropriate direction and control" in the area of safety.

Take A New Look At Inadequate Wiring

A reader has presented us with a challenging question regarding the industry's emphasis on the inadequate wiring problem. We think it entirely worthy of passing along to all of you for your comments.

Here is the question:

"I am wondering if the lack of adequate wiring in existing homes is seriously affecting the sales of appliances. I am wondering if too much emphasis on wiring and its effect on the efficient operation of appliances is causing anyone to buy gas equipment instead of electric.

"When I look through the ads of the automobile manufacturers and read the proceedings of their sales meetings, I find no reference to checking the garage size before a car is purchased.

"I am wondering whether or not we should put more effort in the new home wiring and ease up on how poorly appliances operate if the wiring is not up to par. I am convinced that rarely does a purchaser return the appliance after it is delivered. He usually calls in an electrician and has the wiring improved so the appliance performs.

"These are my personal thoughts and I am just wondering if I'm on the right track."

No matter how certain the industry may be regarding the merits of its existing programs, it is always wise to review activities. Perhaps now is a good time to take a new look at inadequate wiring.

Men Behind Electric Car Look at the P

As the map shows, electric utilities will help steer the course for one of the most intriguing load builders to come along since the electric blanket. About 63 power companies and four cooperatives soon will receive the first 100 production line models of Stinson Aircraft Tool & Engineering Co's electric car. The first few, complete with paint and trim, came out of the San Diego plant this month and are undergoing tests before delivery.

Stinson reports 207 firm orders now in hand. It hopes to have 400-500 dealers in the U. S. by the end of the year. Called the Charles Town-About, the car will retail for $2,895. Here's the outlook of the four men behind the modern day models:

HARKINS

H. Drake Harkins in the last ten days has spent $120 on the Cadillac parked beneath the awning carport near his cooperative apartment overlooking Bahia Mar marina in Fort Lauderdale, Fla. The money went for mufflers, sparkplugs and points, all of which aren't needed in the electric cars that Harkins is sure will be humming through U. S. suburbs soon.

Since he left the University of Missouri campus, Harkins has spent his life with power. A mechanical engineer, he retired in 1957, after 32 years with DuPont. This led him to the board of directors of Atlantic City Electric Co, a job that takes him north for about a week each month. Those other three weeks the last two years have been spent in developing interest in, and ideas for, the car.

The greatest danger to the future of the electric car, says Harkins, is the high pressure salesman. "I just hope the public will not be driven to expecting too much from the Town-About, or any other electric car coming on the market in the next few years."

And Harkins is sure there will be others. A mile from Bahia Mar is Port Everglades where "by 1961, there will be English electrics coming off those freighters. And also by 1961, I won't be surprised if there is an assembly plant in this area for the Town-About." If there is, Harkins will get the Florida distributorship.

A 40-mile range with a speed of 30-35 mph will satisfy millions in the coastal plain, from Wilmington around to Texas, which is the prime market, says Harkins. The first electrics won't be too good in hilly country or in areas like Los Angeles and Detroit with fast throughways. But Florida, with its mild climate and flatness, is perfect.

He is certain the electric must have a built-in charger so it can be plugged in anywhere. It is a good guess that he is not too happy about the Town-About price increase. But he points out this can be tempered by Detroit's mistake in its obsolescence theory and rising gasoline prices and taxes.

Asks Harkins: "Can you imagine what a desperate situation it is in Detroit with a whole generation of auto men brought up with the idea that a man buying a fleet

Utilities, Researchers, Prospective Car Makers Are Optimistic

"We definitely will see the day when electric cars will have a range of 300 to 500 mi as improvements come in the batteries—the one missing link in our realization of the incredible potential of electric energy."—Dr Jacques Bolsey, president, Bolsey Corp.

"Joint efforts of the research division of the Electric Storage Battery Co and Cleveland Vehicle Co have developed components never before used in an electric truck."—Walter Thomas, president, Cleveland Vehicle Co.

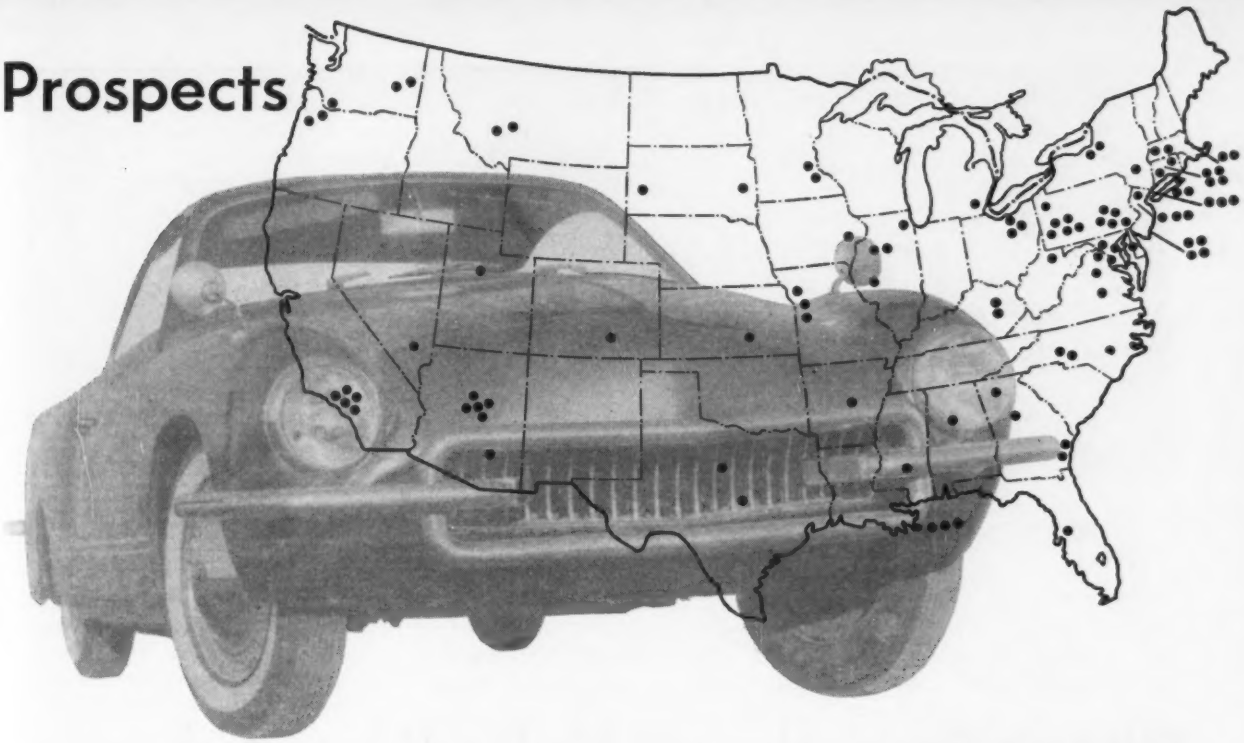
"We are confident that by 1970, fully 50% of the automobiles used in urban areas will be electrically propelled."—A. J. Morroni, general manager, Electric Equipment & Engineering Co.

"Electric power can take its place with other new automotive energy systems which are being sought and inevitably will be developed."—C. F. Nordberg, president, Electric Storage Battery Co.

"American automobile manufacturers, for the most part blissfully ignorant of public demands, have continued to produce wider, longer, heavier, costlier and gaudier Juggernauts . . . Once again, therefore, the concept of an electric runabout begins to offer promise . . ."—Prof. A. J. Pulos, Syracuse University.

"The market for electric cars, even with their present limited service aspects, is tremendous. Literally thousands of business firms and individuals could use the car and profit by its extremely low operating costs. Properly priced, these cars will sell easily without in any way hurting the conventional car market."—Albert Gruber, technical research analyst, Washington Water Power Co.

Prospects



of cars should expect to get rid of them after 40,000 miles? At 40 mph, that is a piece of machinery designed to operate only for 1,000 hours."

ENGLAND

Bayard L. England believes, "If we get the improved battery, you're going to see the greatest push to electric vehicles the U. S. has ever experienced. And we're going to get it, too!"

As board chairman and chief executive officer of Atlantic City Electric Co—first utility to get behind the electric car's rebirth in the U. S.—England cites "rooms full of mail" seen on a recent visit to the Stinson plant as one indication of interest in the car. Development and research work on other cars and on batteries is underway both here and abroad, he adds.

England agrees with Harkins that the electric should be sold in suburbs with flat terrain. Atlantic City's boardwalk already provides a small but ideally timed block of load from recharging tourist cart batteries.

Electrics have "an almost unlimited future," says England. Their simplicity, ease of operation, and virtual absence of maintenance are unparalleled selling points. And the trend to second, third, even fourth cars indicates there is room in the suburbs for a rechargeable runabout. Beyond this are applications such as taxi fleets, small trucks and buses, vehicles and toys for youngsters, and the already popular golf carts.

A man who calls work his hobby, England last month was named board chairman after ten years as ACE president. "Pat" as he's known to the industry, is a Temple University graduate and was president of Edison Electric Institute in 1952-53.

VAN NOY

Deane L. Van Noy, Stinson president, obviously is convinced of the electric car's future and is hopeful his company can meet what looks like a demand for 20,000 cars a year. Chief "bug" to date is weight distribution, notably 700 lb of batteries.

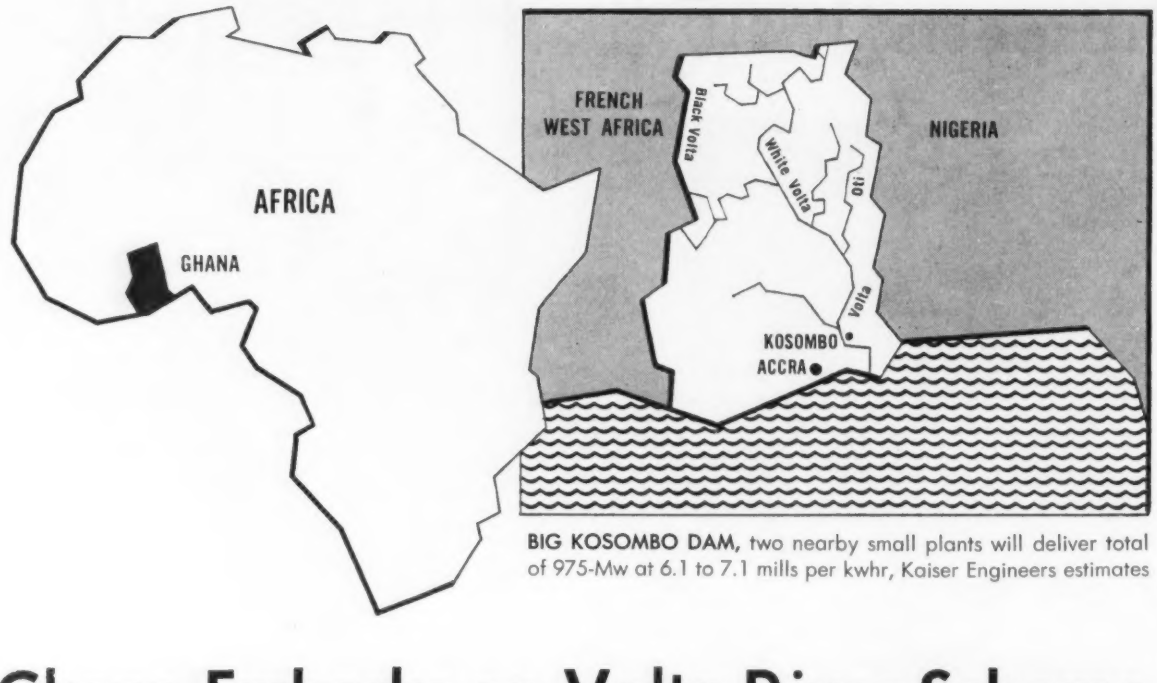
The firm is exercising a tighter control on publicity until Van Noy and his associates personally test the first production line models for several months.

A 43-year-old native of Ohio, Van Noy was an associate of the late Eddie Stinson, an aviation pioneer, whose heirs gave Van Noy permission to use the Stinson name. He established the company five years ago in Chula Vista, Calif., and moved the plant to San Diego a year ago. The plant now has 28 employees; 375-400 men are expected to be employed before 1960 to help meet a Jan. 1 production goal of 500 cars.

GRAVES

Dr Charles H. Graves, 40, Stinson vice president, designed the auto in 1949 that is the forerunner of the present Town-About. He and his brother, also a dentist, hold controlling interest in Stinson. Dr Graves holds several patents and also has presented plans to the U. S. government for an atomic reactor to produce fresh water from the sea.

When mass production tooling is completed, retail price of the Town-About will be lowered to $2,000, but this won't come before next year, Dr Graves says. He and Van Noy feel electric cars can obtain 1%, or 60,000 units, of 6-million annual national car sales.



BIG KOSOMBO DAM, two nearby small plants will deliver total of 975-Mw at 6.1 to 7.1 mills per kwhr, Kaiser Engineers estimates

Ghana Embarks on Volta River Scheme

Small and newly independent, the nation hopes to tap bauxite deposits with 768-Mw capacity dam costing $156 million

An ambitious scheme to industrialize the West African state of Ghana has come to life after six years of discouragement from consultant engineers. Key to the plan is Ghana's swift Volta River, whose power the Ghana government wants to harness with a network of hydroelectric dams, generating plants and transmission stations.

Newly independent Ghana is a symbol of African self-determination. A tiny state the size of Oregon, its freedom from British rule two years ago spurred local aspirations to develop the Volta primarily as a source of power to make possible the manufacture of aluminum from four rich local deposits of high-grade bauxite.

The trouble was, according to engineering studies conducted by the British and Canadians who held financial interest in the bauxite deposits, that a Volta power project would cost so much to build that the resulting electric output would be uneconomic. Most bearish of all reports was a study by British consulting engineer Sir William Halcrow in 1956, which estimated that it would take $900-million to provide 700,000 kw of capacity.

Just last month, however, Kaiser Industries Corp signed a $5-million contract to begin work on a 768,-000-kw dam on the Volta which Kaiser Engineers, Inc, estimates will cost only $156 million. The Kaiser plan is to add two other smaller dams to the main one at the town of Kosombo, plus generating plants and a transmission network that will deliver a total of 975,000-kw capacity at a cost of between 6.1 to 7.1 mills per kwhr.

For aluminum production plants then envisaged according to the Kaiser plan, the power cost would be only 2 to 2.5 mills.

Past Plans Too Ambitious

Kaiser Industries Vice President Chad Calhoun, who negotiated the contract with Ghana's Prime Minister Kwame Nkrumah, says the trouble with previous engineering reports was that they were too ambitious—and included too many subsidiary plans for roads, railways, housing and school developments.

Also, Kaiser has picked a new damsite from the one previously considered at Ajena. Calhoun admits the Ajena site is one where it would be easier to build a dam. But the water flow is not nearly as fast as at Kosombo. Calhoun says Kaiser is taking its chances on the construction problems at Kosombo also because the site itself is more accessible to the hauling of equipment.

Kaiser's interest in the Volta stemmed directly from Vice President Richard Nixon's visit to the Ghana independence ceremonies at Accra in 1957. Nixon came back impressed with Ghana's ambitions to industrialize, and directed State Dept to see if there wasn't some way it could help. Nixon made a pitch for the obvious international political benefits that could stem from U.S. aid in building a sound economic footing for Nkrumah, who represents the more moderate wing of African nationalism. Then when Nkrumah visited the U.S. the following year, he made a special plea for help on the Volta project.

State Dept approached Kaiser, Calhoun recalls, and got that company's agreement to take another look at the Volta project. The International Cooperation Administration picked up half the cost of the Kaiser Engineers' study last year.

Because of its diversification—power dams, steel, chemicals, cement, electronics and autos as well as aluminum—Kaiser was willing to tackle the job.

But the eventual realization of the Volta project depends on more than the building of the dams and power plants. This is where aluminum comes in.

Aluminium Co of Canada holds a 90-year lease on Ghana's bauxite deposits. British Aluminium Co, Ltd., has been mining it for years. But aluminum producers hadn't given more serious attention to the production potential in Ghana because of the high cost estimates on electric power.

Now that Kaiser is actually starting work on the Kosombo Dam site, however, interest in the aluminum industry has picked up sharply. Kaiser itself, says Calhoun, is "certainly interested" in building a bauxite reduction plant and aluminum production facilities in Ghana.

Reynolds Metals Co has since acquired controlling interest in British Aluminium, and it too sent Vice President Walter L. Rice to Accra recently to talk business with Nkrumah.

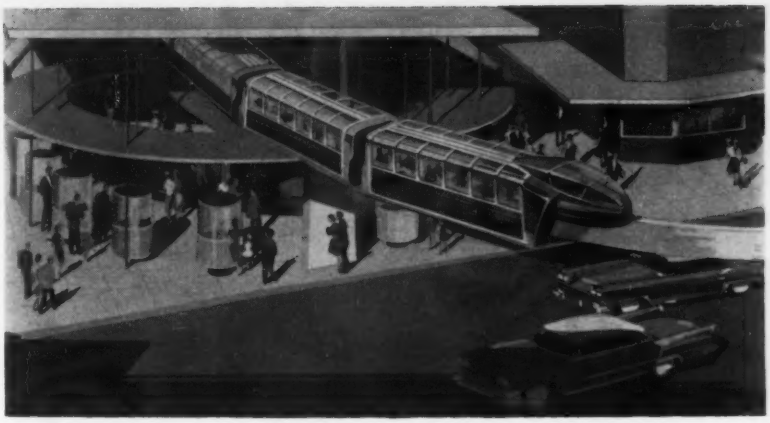
Reynolds and another U. S. firm, Olin Mathieson Chemical Co, are in an infant aluminum production experiment in nearby Guinea, along with the French aluminum producing firm, Pechiney.

Project May Get U. S. Aid

The U. S. government meanwhile, may help the project along as well. Nkrumah is sending a financial delegation to Washington in the next few weeks to talk loans with the World Bank and the U. S. development loan fund. World Bank staffers say they will give the revived project an open-minded look.

Nkrumah already has said he will put up $56 million of the Kaiser-estimated $156 million it will take to build the Kosombo Dam. This he can do easily out of an estimated $700 million in gold and dollars Ghana has in its reserves from its earnings as world cocoa supplier. Ghana is expected to ask help on the remaining $100 million out of some sort of public fund lending agency.

The U. S. State Dept, however, thinks potential power users may also chip in.



Seattle Plans Monorail for Exposition

Contracts have been signed for the construction of a $5-million, 1-mi monorail system to provide Seattle's business district with a fast link to a "Century 21 Exposition" site. Lockheed Aircraft will be the prime contractor. The system will include three "airtrains," supporting structures, and terminals. Trains will be largely of aluminum construction, powered by electric motors. Destined to be the first operational monorail line ever installed within a city to solve a mass transportation problem, the system will be ready Nov. 1, 1960. After the two-year exposition closes, the monorail will be used at the direction of the Seattle Transit System.

Bonneville Tie Line Study Proposed by Interior Unit

A joint study on the need for a federal or private high-voltage power interconnection between California and Bonneville Power Administration has been recommended by the Senate Interior Subcommittee on Irrigation and Reclamation. It undoubtedly will be approved by the full Interior Committee.

The study would be made by representatives from the Federa Power Commission, Bonneville, Northwest Power Pool and governors of Washington, Oregon and California.

The recommendation stems from recent hearings on a proposal by Pacific Gas & Electric to build—in conjunction with California-Oregon Power Co—a 90-mile, $4-million, 230-kv line connecting Bonneville with PG&E's San Francisco load center. The public-power-dominated subcommittee called for a halt in the PG&E-Bonneville negotiations until an alternate $75-million federal line, connecting Bonneville with the federal Central Valley Project, Calif., could be considered (EW, April 20, p 80).

In recommending the study, the subcommittee repeated its request that Bonneville-PG&E negotiations be halted until the study is finished, probably about July 15.

Bill to Establish Consumer Counsel Passes in California

The California legislature has passed a bill to establish a consumer counsel in the governor's office. Most important function of the office will be to represent the public at utility rate hearings before the state Public Utility Commission, said the bill's author, Sen Richard Richards, Los Angeles Democrat.

Gov Edmund Brown said he would sign the bill and appoint a woman to the $15,000-a-year post. The counsel will advise Brown on matters "affecting the interests of the people as consumers and recommend legislation deemed necessary to protect and promote the interest of the people as consumers," the governor said.

Veto Probable on TVA Bill As It Now Stands

Approved by the House, the measure doesn't conform to President's budget message; Senate action expected in June

A bond financing bill for the Tennessee Valley Authority was approved last week (245-170) by the House of Representatives amid predictions that the bill in its present form probably will be vetoed by President Eisenhower.

Rep William Cramer (R-Fla.), who spoke lengthily on the House floor against the measure, pointed out that, "Based on the President's 1958 and 1959 proposals in his budget messages concerning this matter, I cannot see how the bill can be signed in its present form." The bill's supporters clearly do not have enough votes to override a possible veto.

Kerr Bill Doesn't Limit Area

The House bill now goes to the Senate Public Works subcommittee on rivers and harbors for hearings—probably not until early June. Subcommittee Chairman Robert S. Kerr (D-Okla.) has had his own bill (S-931) pending before the subcommittee since January, but he has delayed scheduling hearings on it until the House completed action on its bill. The Kerr bill has no definite territorial limitation, as in the House bill.

The House-passed measure (HR 3460), introduced by Reps Robert Jones (D-Ala.) and Clifford Davis (D-Tenn.), is identical to the form in which it was recommended earlier by the House Public Works Committee. It provides: **1.** A $750-million limit on total bonded indebtedness. **2.** A 15-day notification period to the Secretary of the Treasury on proposed new bond issues plus an additional 45 to 75-day delay period, if the Secretary requests. **3.** Congressional disapproval of proposed bond-financed projects within 90 days of notification—whether Congress is in or out of session. **4.** A required annual payment of $10 million to the U. S. Treasury on TVA's appropriated debt. **5.** The "Vinson amendment," which limits TVA to its existing service area on July 1, 1957, except for eight specifically named towns—Paducah, Princeton and Glasgow, Ky., Covington, Dyersburg and South Fulton, Tenn., Chickamauga and Ringgold, Ga.

Attempts by the bill's supporters to punch more holes in the restriction on TVA's service area were defeated, one by a vote of 35-123 and the other by an uncounted voice vote.

However, the bill's supporters had their way in knocking down all amendments proposed on the House floor to add more governmental controls to the measure.

An amendment to place TVA's operations squarely under Congressional control and within the Government Corporations Control Act was defeated 129-170; an amendment to place TVA's financial operations under Presidential budgetary review was defeated 89-130; and three other amendments were each defeated by unrecorded voice votes: **1.** To give the Treasury Department the right to schedule TVA bond offerings. **2.** To subordinate TVA bonds under Congressional appropriations. **3.** To reduce TVA's repayment period on appropriated funds from 120 to 60 years.

A final attempt to delay the bill on the House floor—a proposal to send the measure back to committee for more hearings—was defeated 182-231.

Right of Way Meeting Set

A St. Louis section meeting devoted to utility right-of-way matters has been set for May 26, the American Right of Way Association has announced. The one-day session will precede the ARWA fifth annual seminar May 27-28 at the Chase-Park Plaza Hotel. Utilitymen will discuss standardization of R/W procedures, reduction of acquisition costs, and methods of using, maintaining and protecting R/W.

Cordiner Favors Liberal Trade Policy

General Electric President Ralph Cordiner came out last week for a generally liberal overall U. S. trade policy, saying "You cannot build a tariff wall around the U. S."

Cordiner spoke at an informal meeting of the Business Advisory Council of the Commerce Department at Hot Springs, Va. Cordiner, whose company has played a leading role in the industry campaign for import protection on heavy electrical equipment on security grounds, said he doesn't expect a favorable decision in the now pending case before the Office of Defense Mobilization. A ruling is expected from the OCDM shortly.

RATE AND REGULATION BRIEFS

One-year rate freeze has been proposed in Delaware legislature. Bill would bar change of existing rate within a one-year period after PCS grants or denies rate change.

Boston Edison has requested a $4,520,000 a year hike to compensate for higher taxes and labor costs. The 4.2% advance would increase residential minimum from $1.15 to $1.45.

Demand meter removal would begin by Houston Lighting & Power Co, providing rate increase is granted until full-scale hearing in November. Temporary change would up minimum bill from 50¢ for 12 kwhr to 75¢ for 16 kwhr. Next 64 kwhr would be 2.9¢ each and next 120 kwhr, 2¢. All additional kwhr would be at 1.5¢. Also proposed was a winter schedule of 1¢ for everything over 900 kwhr.

Tells MVEA Utilities Are Losing By Default

President Arnold asserts at Kansas City that industry neglects public as ally in fighting for free enterprise

DUANE ARNOLD gives presidential address to MVEA. Edwin Vennard, EEI vice president (center) was speaker, and G. S. Whitlow group general chairman

By default, utility companies are losing out to public power advocates and the government, the Missouri Valley Electric Association was told by its president at its April 15-17 meeting in Kansas City, Mo.

"We have permitted public apathy to develop to such an extent that the public will do nothing to prevent the government from cutting off our freedom to advertise, to disagree, and to fight for free enterprise," declared Duane Arnold, who is also vice president and general manager of Iowa Electric Light & Power Co.

Southwestern Electric Power Co is installing a 100-Mw unit designed for peaking service, said R. A. Neal. Steam conditions, he said, will be 1,450 psig, 1,000F without reheat, and the estimated cost will be 87% of that of a reheat unit. Growing difference between peak and base load, and favorable gas rates for older units normally operated for peaking, prompted the installation, he explained.

Data logging in steam plants not only improves information but also allows the operator to give more attention to monitoring unit performance, said R. A. Russell, Black & Veatch, consulting engineers. The data logger evaluates some data and is a step toward plant automation, he added.

Union Electric Co overhauls steam turbine generators when overhaul is justifiable rather than on regular schedule, said J. F. McLaughlin Jr. Machine performance, such as vibration and increase in turbine stage pressures, is observed and recorded, he said, adding that turbine testing has enabled the company to lengthen intervals between overhauls.

Kansas Gas & Electric Co schedules the economic loading of generators through a No. 604 IBM computer, said N. F. Pinkstaff. The set-up on the IBM system, he said, supplies data for scheduling generation economically, for evaluating overtime requirements and machine outage costs. It also reduces the cost and time of producing a new schedule for fuel cost changes and affords a better perspective of fuel costs.

Cuts Fuel Bill

A ½% cut in the fuel bill more than justified Southwestern Electric Power Co's installation of automatic dispatching equipment, said W. A. Googe. This equipment was described by R. L. Tremaine, Westinghouse, who said it computes the cost of the last increment of power delivered and loads stations for most efficient generation. It recognizes serious system conditions and makes maximum use of available generators.

Epoxy resin has been used successfully since 1952 by Oklahoma Gas & Electric underground crews, said D. D. Canada. It has been used in low-voltage splices from lead to rubber, in tee lug connectors, for oil stop joints on oil-impregnated paper lead cable, on paper lead 12.5-kv terminations, and as complete insulation of bushings subjected to contamination. The epoxy resin technique requires less materials, equipment, and time.

Cable failure rates are reduced by high-voltage dc tests to locate weak points in cables, said R. A. Nelson, Simplex Wire & Cable Co. Tests are made during light load, when network feeder cables can be taken out of service.

Positive ventilation of vaults by fans improves the transformer cooling in hot weather heavy-load periods, said S. W. Murray, Jr., Southwestern Electric Power. His company, he said makes effective use of signal lights to indicate protector operation and of walkie-talkie communications between underground and substation crews.

Oklahoma Gas & Electric's method of monitoring transformer loads through kwhr use has been improved often since 1940, said Tom Hoke. Most recent improvement, he said, has been the use of punch cards, allowing the monitoring of all 50,000 transformer station loads every year at an annual cost of $10,000. Set-up cost was $80.

Substation design, incorporating five motor-operated disconnects on the 34-kv side, instead of five oil

(*Continued on page* 88)

Plant Distribution Combines Economy,

Standardization of power centers and primary distribution cable reduces first cost. Spare equipment is provided for all critical components in two highly automated lines

D. J. VACCARO, Senior Electrical Engineer, Singmaster & Breyer, and

GORDON MUNZEY, Electrical Superintendant, Ormet Corp.

High reliability and extensive standardization of equipment are the outstanding characteristics of the electrical distribution system at Ormet Corporation's new Burnside, La., alumina plant. Particular emphasis was placed on service continuity to critical equipment in the two highly automated parallel process lines. Standardization of similar equipment produced significant economies both in first cost and in the anticipated maintenance costs. Where economically justified, provision was made for future expansion of the power system. To assure continuous production, spares are provided for all critical items.

Ormet is jointly owned by Olin Mathieson Chemical Corporation and Revere Copper & Brass Incorporated. It produces primary aluminum for both firms. The Burnside plant produces 36,000 tons of alumina annually for Ormet's reduction plant at Hannibal, Ohio.

Most of the motors rated 200 hp or larger are served, through five 4-kv distribution centers, at the 4,160-v generation voltage. These distribution centers also supply the 480-v power centers, from which all other motors are served. For reasons of economy, the 480-v power centers were standardized at 1,000 kva. Similarly, primary distribution cable was standardized at 350 Mcm throughout the plant. Parallel conductors were used as required.

A single type of cable was installed in cable trays, overhead on steel poles, and underground in conduit. No. 4/0 cable was used for distribution to all power centers; No. 6, to all 4-kv motors.

Principal factors affecting the selection of utilization voltage for the larger motors were: **1.** the length of cable runs from the distribution centers to the motors, and **2.** the desire to keep the 480-v power centers within the 1,000-kva limit.

The 4,160-v system is resistance grounded to limit equipment damage on ground faults. The 480-v and lower voltage systems are solidly grounded to insure tripping on fault conditions.

Each of the five distribution centers consists of 5-kv metal-clad switchgear, 480-v metal-clad switchgear, and the motor controls centers, all housed in a masonry building. The 4,160/480-v transformers are located immediately outside the building walls and are connected to the 480-v switchgear by a short section of bus duct. Each distribution center building is pressurized to protect the equipment from dust and corrosive vapors. If the positive pressure in the building is lost for more than a few minutes, differential switches sound an alarm.

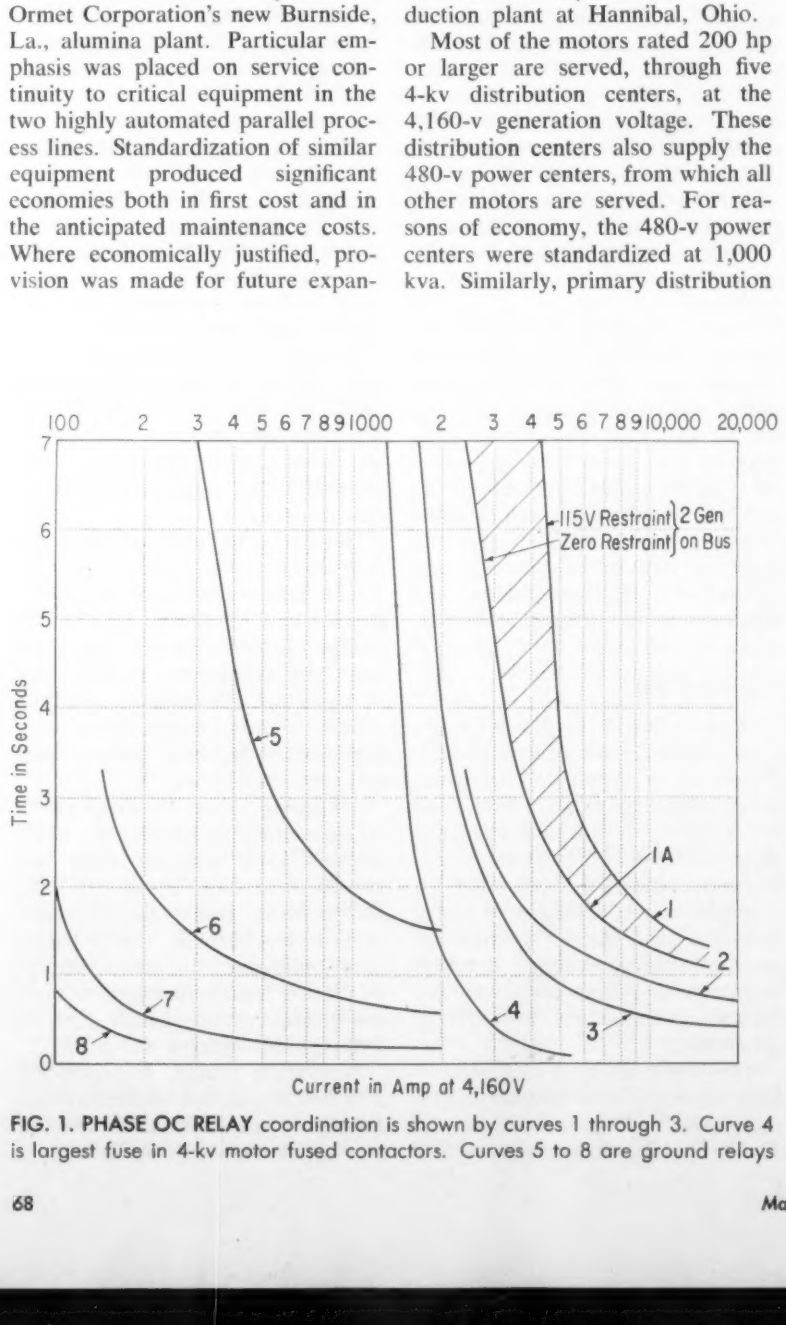


FIG. 1. PHASE OC RELAY coordination is shown by curves 1 through 3. Curve 4 is largest fuse in 4-kv motor fused contactors. Curves 5 to 8 are ground relays

4.16 Kv Most Economical

Three 5,000-kva, 80% power factor, 3,600 rpm, 4,160 v, 3-phase, 60-cycle steam turbo-generators generate the electric power. Two generators will supply the connected load of 20-Mva, since it was anticipated that the overall demand factor would be 50% of connected including spare. The third generator firms up the output of the other units.

Voltages considered for generation were 13,800, 6,900, 4,160 and 2,300 v. Ultimately, 4,160 volts was selected, since it was most economical to transmit power at this voltage to the five distribution centers, located from 500 feet to 900 feet from the generating station, and distribute power directly to the large motors at generated voltage.

In arriving at this decision, all of the economic factors of transformation, transmission, distribution, circuit protection, and motor control were evaluated.

The station switchgear consists of metal enclosed draw-out air circuit breakers, with two bus sections connected through a normally closed tie breaker (Fig 2). Two generators are connected to one bus section and the third generator to the second bus section. All of the 4-kv station breakers have a 350-Mva interrupting rating and a momentary rating of 80,000 RMS symmetrical amp, which will also be adequate for an ultimate 30,000-kva installed capacity. Generator and feeder breakers have a continuous current rating of 1,200 amp; the tie breaker, a rating of 3,000 amp. To simplify manual load shedding, five identical feeder circuit breakers are arranged on each bus section in order of priority. All circuit breakers are controlled at 125 v dc, supplied through a station lead acid battery.

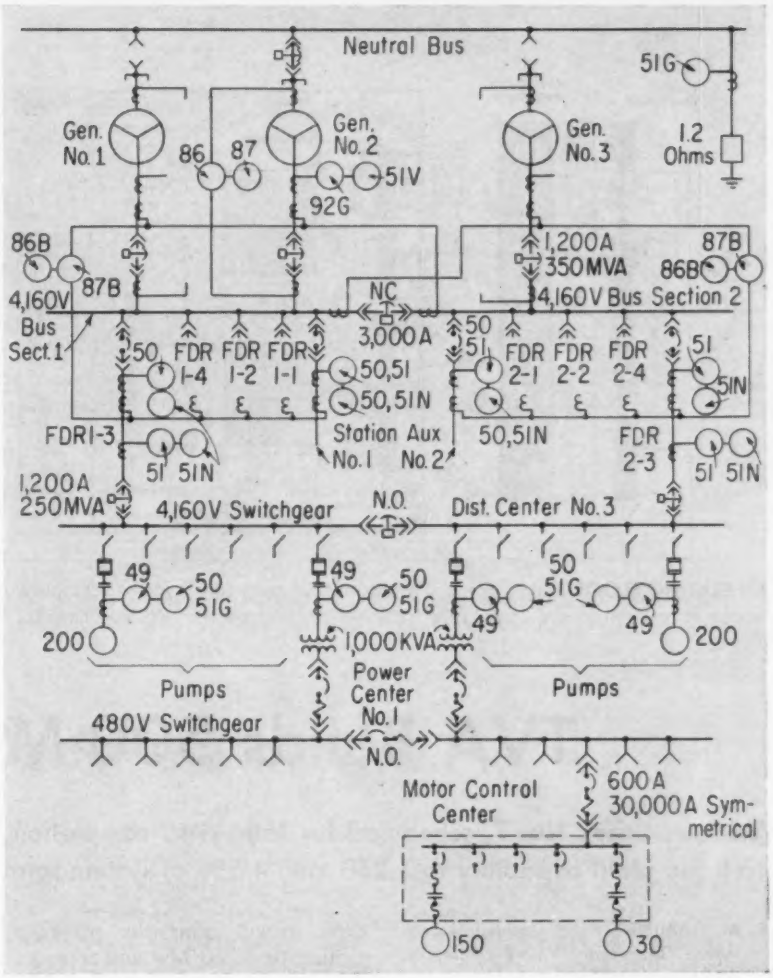


FIG 2. MOTORS 200 HP OR LARGER are served directly at 4,160-v generation voltage. The 4,160-v system is resistance grounded; 480-v, solidly grounded. Although two neutral air circuit breaker elements are provided, interlocks prevent more than one neutral from being connected to the neutral bus at any time

Bus Has Differential Protection

Each generator is protected by three high speed differential relays, three time-overcurrent relays with voltage restraint, and a 3-phase power directional (anti-motoring) relay. Although the bus sections are housed in the metal clad switchgear lineup, which minimizes bus faults, it was decided to provide differential protection for each bus section by over-current relays. Each feeder is protected by two time-overcurrent phase relays and one residual ground fault relay. The grounding resistor is protected by a time-overcurrent relay which also serves as a backup for the feeder ground fault relays.

An annunciator on the control board provides an audible and visual alarm to indicate: overcurrent tripping of each feeder and generator circuit breaker; differential tripping of each bus section; differential tripping of each generator; high air temperature of each generator; an ungrounded system; closing of more than one neutral breaker; or an open bus-tie breaker.

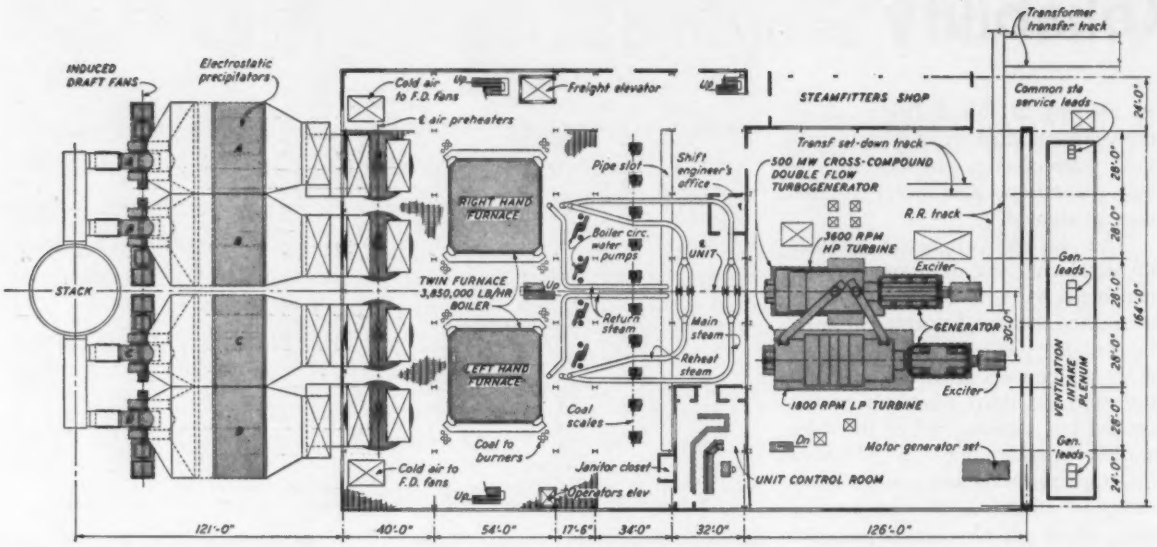
A 4-kv distribution center is strategically located in each of the five main process areas. Centers No's. 1, 2 and 3, which serve the more critical areas, are supplied by two 4,160-v feeders.

Distribution centers No's. 1 through 3 consist of a metal-clad lineup of three draw-out air circuit breakers—two incoming line breakers and one normally open tie breaker—and combination fuse and contactor units. The circuit breakers have a 250-Mva interrupting capacity and 1,200-amp continuous current rating. They are provided with d-c solenoid closing mechanisms operated from a-c control power transformers and rectifiers. A 48-v battery at each lineup provides a reliable tripping current source. The fused contactors, which are the motor starters for the 4-kv motors, are located on both sides of the incoming line circuit breakers. Thus when expansion takes place, additional units can be added to each end of the lineup.

Distribution centers No's. 4 and 5, which serve less critical equipment, have one incoming line breaker, with a lineup of fused contactors.

The single conductor cables from the generator station switchgear are supported on galvanized steel cable trays in the power house. These trays are continued out of the power house and supported on structural steel framework which also supports plant piping. Where piping supports were not available, steel messengers suspended on a line of steel poles were used.

(*Continued on page* 132)



OPERATING-FLOOR PLAN shows the location of twin furnaces in relation to the cross-compound turbine and other major components at the Tennessee Valley Authority's Widows Creek Steam Station on the Tennessee River

TVA Builds 500-Mw Steam Unit,

Widows Creek No. 7, scheduled for late 1960 completion, to bring plant capability to 1,250 Mw, 4.5% of system total

R. M. GARDNER, Head Mechanical Engineer, Tennessee Valley Authority, Knoxville, Tenn.

The largest steam generating unit yet ordered in the U. S. is now under construction by Tennessee Valley Authority, a 500-Mw unit to cost an estimated $172 per kw of nameplate. It will have:

1. A cross-compound, double-flow, 2,400-psi, 1,050/1,000F turbine.

2. Two 250-Mw generators having direct cooled conductors, utilizing oil and hydrogen, one rotor being conventionally cooled.

3. A controlled circulation, coal-burning boiler having twin furnaces joined at the top with a common steam drum.

4. A heat balance providing a calculated net plant heat rate of 8,913 Btu per kwhr at 544-Mw net output.

5. Two half-capacity, steam-turbine-driven boiler-feed pumps.

The unit is the seventh to be constructed at Widows Creek Steam Plant. When finished in September, 1960 it will bring the plant capability to 1,250 Mw and represent about 4½% of the system capacity.

The turbine is a 3,600/1,800-rpm, cross-compound, double-flow unit designed for initial steam conditions of 2,400 psig, 1,050F with reheat to 1,000F, 3½-in. Hg back pressure, 3% makeup, with full extraction for eight stages of feedwater heating. The 3,600-rpm, high-pressure shaft has a single-flow, high-pressure turbine, a double-flow, intermediate-pressure turbine, a 250-Mw generator, and a 1,250-kw direct-connected exciter. The 1,800-rpm, low-pressure shaft has a double-flow, low-pressure turbine, a 250-Mw generator, and a 1,000-kw direct-connected exciter.

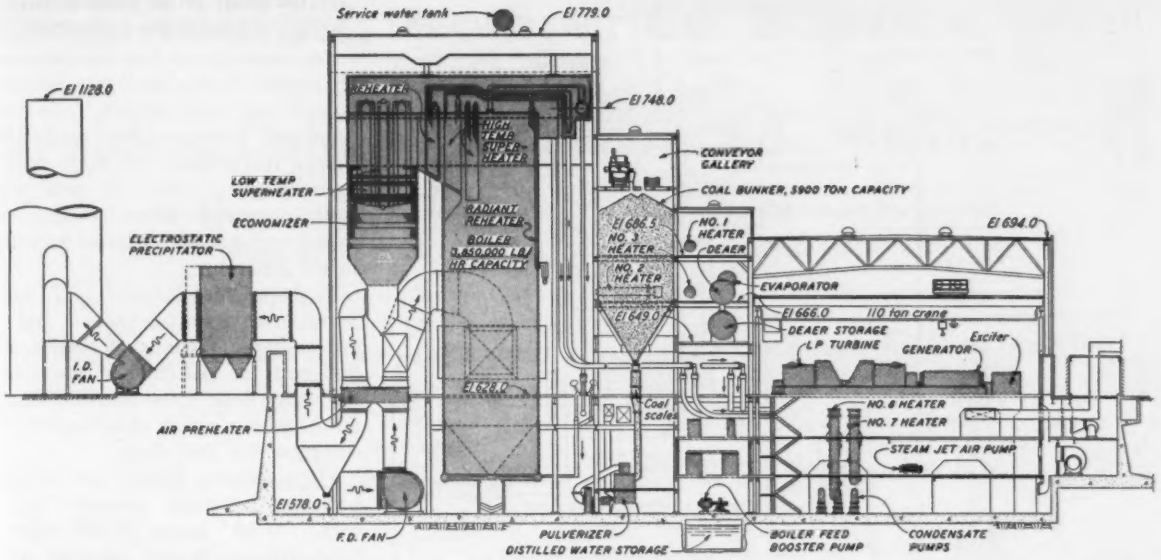
Turbines Split Load

Main steam from the boiler is supplied to the high-pressure turbine through two stop valves and four control valves; the maximum steam flow through the high-pressure turbine with all valves wide open is 3,800,000 lb per hr. Exhaust steam from the high-pressure turbine at 487 psig, 647F is returned to the boiler, where it is reheated and returned through two interceptor valves to the intermediate-pressure turbine at 437 psig, 1,000F. Two 42-in.-dia crossover pipes carry the intermediate-pressure turbine exhaust steam to the 1,800-rpm, low-pressure turbine, which in turn exhausts to the condenser.

Both turbines are designed to split the load, so that both generators are rated 277,778 kva, 0.9 pf, 3-phase, 60 cps, 24 kv, 0.7 short circuit ratio at 27-psi hydrogen. Each has a capability of 319,450 kva, 0.61 SCR at 45-psi hydrogen.

The stators of both generators are direct-cooled with oil circulated through the hollow conductors from an external system of pumps and coolers. The rotor of the high-pressure unit is direct-cooled with hydrogen circulated from an internal closed system of shaft-mounted fans and coolers. The low-pressure rotor is conventionally cooled with hydrogen.

Each generator is excited by its shaft-driven, 375-v, 716-rpm geared exciter. A 1,250-kw, high-inertia motor-generator set will start and



TRANSVERSE SECTION of Widows Creek Station shows downdraft design with air preheaters, precipitators, and induced-draft fans at the ground level. Reinforced-concrete stack is 500 ft high. Building is entirely enclosed

t, Largest Yet Ordered in U.S.A.

serve as a spare exciter for either unit. The resistance of the generator fields is such that applying the same voltage to both will result in correct excitation for starting without the use of external resistors.

Each generator is connected solidly to a 300-Mva, FOA, 55C, 22.5—161-kv, 3-phase, transformer and paralleled on the high side only. This arrangement permits the use of transformers which duplicate several others on the system and, at the same time, limits fault current on generators and buses.

Connections to the existing 161-kv switchyard will be through a 15,000-Mva, 2,400-amp, 3-cycle oil circuit breaker which will be the highest-rated breaker in this voltage class.

Auxiliary power is normally taken from a 10/12.5-Mva, OA/FA, 22.5-4.16-kv transformer connected solidly to each generator bus. Auxiliary power for starting, emergency, and common station uses is supplied from the existing station and a new common transformer connected to the 161-kv system. The neutral of the 4.16-kv system is grounded through a resistor. Throwover from normal to common system is automatic.

The steam generator is a twin-furnace, controlled-circulation, dry-bottom, tangentially fired unit, having a rated continuous steam capacity of 3,850,000 lb per hr. Steam conditions are 2,450 psig, 1,053F at the superheater outlet and 454 psig, 1,003F at the reheater outlet, with feedwater temperature of 530F.

Both furnaces are identical in design. Each contains superheater, reheater, and economizer surfaces. Joining the two furnaces is a common steam drum 60-in. inside dia, 6⅞-in. wall thickness, 79 ft long, weighing 180 tons. The steam drum is 170 ft above the basement floor level.

Heat Release 11,000 Btu

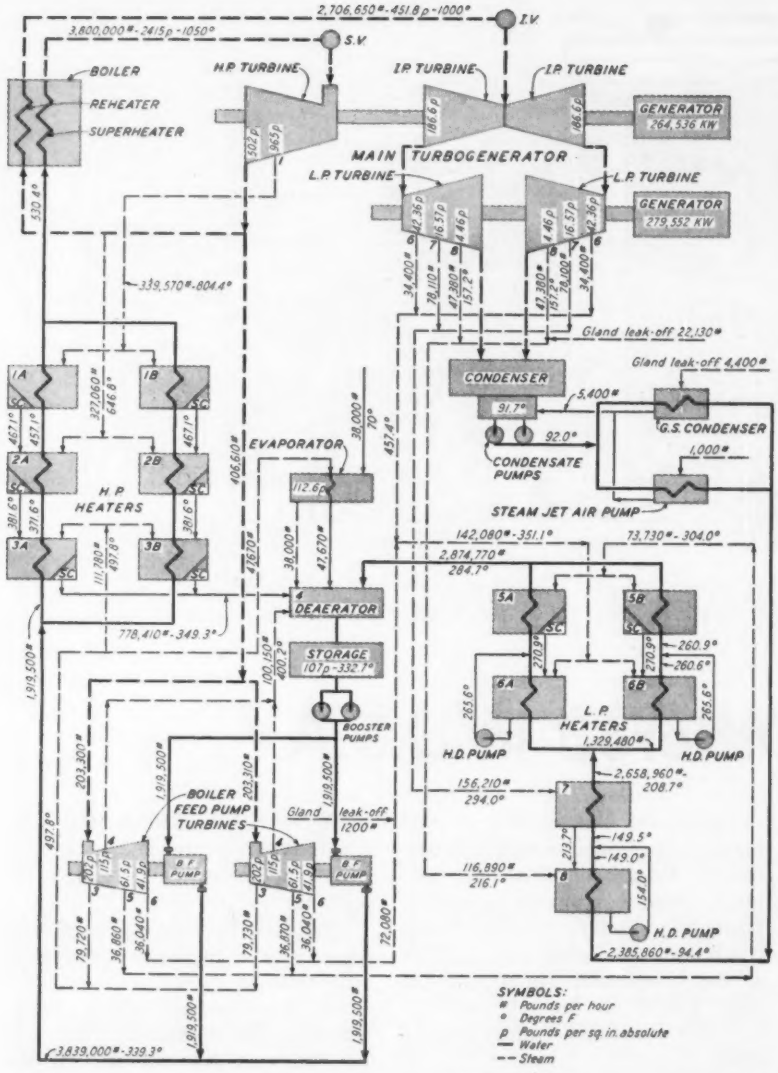
At rated load, the boiler will burn 204 tons of coal per hr when using West Kentucky coal in 40 tilt-type burners. Five burners are at each corner of the two furnaces. Nozzles can be added for future gas firing. The heat release is 11,000 Btu per cu ft per hr, and the heat available in water and steam-cooled, flat-projected furnace envelope is 71,600 Btu per sq ft. The temperature of the gas leaving the furnace will be 1,995F. After passing through four regenerative, vertical-basket-type air preheaters, the exit gas temperature (uncorrected for leakage) will be 290F.

The boiler will be equipped with an automatic, sequentially operated, soot-blowing system designed for steam as a blowing medium and for electric-motor operation. There will be 104 wall blowers and 32 retractable blowers.

The condenser is a 200,000-sq-ft, horizontal, single-pass, divided waterbox unit, with a welded connection at the turbine exhaust and a rubber belt, dog-bone-type expansion joint in the condenser neck. Air is removed by a two-stage, twin-element steam jet air ejector, each element designed for a maximum condensate flow of 2,700 gpm.

Heat balance diagram is shown for 1½-in. Hg back pressure. At 1% makeup, 3% auxiliary power, and 1% of throttle flow for combined steam and water losses in the boiler, the calculated net plant heat rate is 8,913 Btu per kwhr, and the generator net output is 544,088 kw.

A study of drives for boiler feedwater pumps revealed that very substantial savings could be made by use of turbine drives. Turbine drives reduce first cost by about $200,000,



HEAT BALANCE provides a net heat rate of 8,913 Btu kwhr for net generation of 544 Mw and 1½-in. Hg back pressure. Extraction will be at 8 pressure stages

and boost cycle efficiency 0.2% and plant capability 12,500 kw.

Two nominal half-capacity, barrel-type, three-stage boiler feed pumps, each rated at 4,000 gpm at a total dynamic head of 7,500 ft, are being provided. Each will be driven by a 10,000-hp, 6,600-rpm, dual-pressure, direct-connected, non-condensing, extraction-type steam turbine designed for variable-speed operation to control flow. Turbines will normally receive steam at 487 psi, 647F from the cold reheat line. For startup and low-load operation a supplementary steam supply from the main steam line at 2,400 psi, 1,050F is provided.

About 65% of full-load rating of the main unit can be carried with one pump out of service. Two motor-driven, boiler-feed booster pumps, each with a capacity of 4,700 gpm at a total dynamic head of 225 ft, precede the steam-turbine-driven pumps in the feedwater cycle. Also provided is a 270-gpm, 700-ft total dynamic head, motor-driven pump for startup.

The heat cycle allows for extraction at eight pressure stages. The two highest and two lowest stages are from the main turbine, and four intermediate stages from the feedwater pump turbine drives. Condensate will be pumped, in order, through the gland steam condenser and the steam jet air pump in parallel, four stages of low-pressure feedwater heaters, and into the deaerating heater. Boiler feedwater booster pumps will take suction from the deaerator storage tank and discharge directly to the main feedwater pumps, which in turn will pump through three stages of closed high-pressure heaters into the steam generator.

High-pressure heaters 1, 2, and 3 and low-pressure heaters 5 and 6 are in parallel banks of two, each designed for one-half of the total feedwater flow. Low-pressure heaters 7 and 8 are each in a single shell designed for full flow.

High-pressure heaters are of the horizontal, U-tube, two-pass type, with 70-30 cupro-nickel tubes. Low-pressure heaters are of the vertical, U-tube, two-pass type and have inhibited admiralty tubes. The deaerating heater is a non-metering contact tray-type deaerator designed for a flow of 3,839,000 lb per hr, oxygen content not exceeding 0.005 cc per liter.

Cycle Storage Split

Cycle storage is split between the deaerator storage tank and a high-capacity pump supplying water to the dearator from the distilled water storage well. This arrangement is more economical than full-storage in the deaerator tank.

In the draft system are four induced- and four froced-draft fans. Each type is designed to operate in parallel from the automatic combustion control. Variable-speed control was selected for induced-draft fans to save power at rated load, to save power and reduce maintenance at lower loads, and to provide more stable control of furnace draft.

Straight electrostatic precipitators with a 90% efficiency will collect fly ash. Although the first cost of the precipitator is more than for a mechanical collector installation, the difference is more than offset by the fan's lower horsepower requirement due to the lower pressure drop. Four silicon-type rectifier precipitators are provided, each having a normal gas flow capacity of 400,000 cfm at 280F. Their arrangement permits adding a later section to increase collection efficiency to 95%.

(*Continued on page* 116)

Welding Data for Aluminum Bus, Connectors*

Welding data are provided on aluminum bus construction for generator leads and switchyard bus; compiled by a Midwestern utility†

Welding Operations for Generator Leads

Material Used — Aluminum 5 in. x 6 in. integral web H-section 78411 bus. (Aluminum tubing 2 in. SPS)

Type of Connector	Number of Connectors	Man-Hours Each Connector	Total Man-Hours
CONNECTORS			
Aluminum Elbows for connecting integral web H-section bus	9	16	144
Connection from H-section bus to disconnect switch made in field	6	8* 14**	48 48
Aluminum end connector 2 in. SPS to 336 Mcm ACSR	3	4	12
Aluminum straight connectors for 336 Mcm ACSR	6	4	24
Aluminum straight connectors for 2–1,272 Mcm aluminum cable with tongue drilled to be bolted to OCB bushing terminal	12	4	48
Aluminum straight connectors for welding 2–1,272 Mcm Al. cable to H-section bus-using 1 tank of argon gas/day	15	12	180
Aluminum 2 in. SPS to H-section bus	3	7	21
Total Man-Hours			561
Total Labor (Wage scale $3.26/hr)			$1829

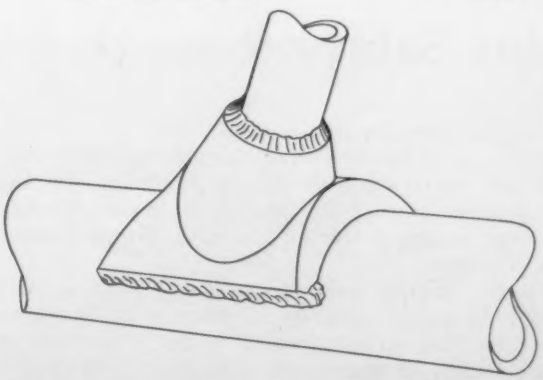
*Fabrication
**Welding

ACCESSORIES	
40 lb ⅛-in. No. 26 aluminum rod at $1.25/lb	$50
15 tanks of argon gas at $41.50/tank	622
9 Prestolite tanks for preheating at $2.00/tank	18
Total Cost Less Overhead, etc.	$2519

Welding Operations for Switchyard Bus

Type of Connector	Number of Connectors	Man-Hours Each Connector	Total Man-Hours
Aluminum T-Connector 2½ in. Al. to 2/0 Al. Cable	6	3	18
Aluminum T-Connector 2½ in. Al. to 636 Mcm ACSR	6	3	18
Aluminum T-Connector 2 in. Al. to No. 2/0 Al. Cable	3	3	9
Aluminum T-Connector 1 in. Al. to 336 Mcm ACSR	3	3	9
Aluminum T-Connector 1 in. Al. to 636 Mcm ACSR	1	3	3
Aluminum T-Connector 1 in. Al. to 1 in. Al. SPS	6	3	18
Aluminum T-Connector 2 in. Al. to 1 in. Al. SPS	15	5	75
Aluminum V-Connector 2½ in. Al. to 2 in. Al. SPS	18	9	162
Aluminum Angle T-Connector 2½ in. Al. to 2 in. Al. SPS	36	6	216
Butt Welding 2½ in. to 2½ in. Al. SPS	12	6	72
Butt Welding 336 Mcm ACSR to 1 in. Al. tubing	9	6	18
Total Man-Hours			618
Total Labor (Wage Scale $3.26/hr)			$2015

ACCESSORIES	
60 lb, ⅛-in. No. 26 aluminum rod at $1.23/lb	$75
20 tanks argon gas at $41.50/tank	830
Total Cost less Overhead, etc.	$2920



Welded Aluminum Angle T-Connector (Item 9 above)

* Brenner, Morris. Vice President-Engineering, Penn Union Electric Co, Erie, Pa.

†Similar welding data for generator leads and switchyard bus, provided by a Southwestern utility, were published in Electrical World, April 20, 1959, p 102, and May 4, 1959, p 72, respectively.

TCA Controls Conifer Growth

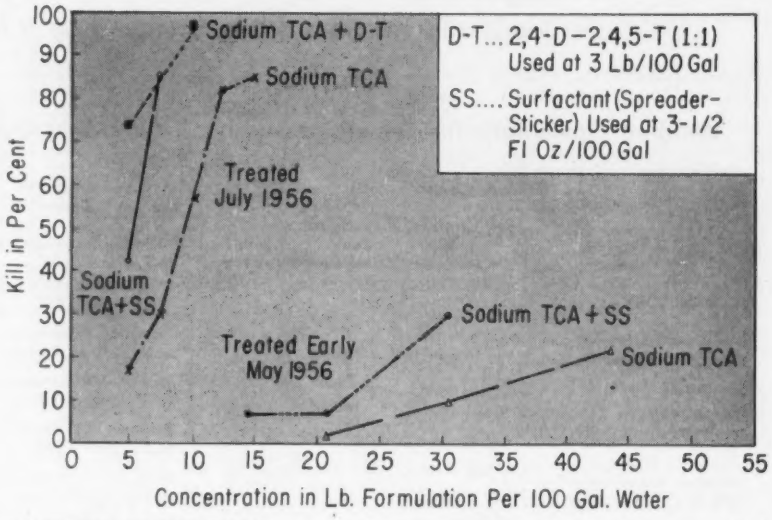
J. M. **BENNETT**, Chemical Research Dept, Hydro-Electric Power Commission of Ontario, Toronto, Ont.

Effective control of fast-growing conifers can be accomplished by using sodium trichloroacetate. Test operations indicate that the chemical (known also as TCA) is also economical to use.

Extensive and successful field trials with TCA have been conducted, and during 1957 and 1958 several hundred acres were sprayed at a cost considerably below that of cutting. Species tested were predominantly balsam fir and black spruce, with some white cedar and white pine.

Tests were conducted on some 280 plots, comprising more than 10,000 individual stems. A total of 30 formulations of 18 chemicals was used. Combinations of certain of these chemicals with a surface-active agent and with 2,4-D—2,4,5-T (1:1) were also evaluated. Varying success was noted.

The value of TCA can be enhanced by the addition of a surface-active agent to improve spreading and sticking properties. This permits the use of a lower concentration, reducing cost. The combination of TCA with 2,4-D—2,4,5-T herbicides also increases its effectiveness. The 2,4-D—2,4,5-T herbicides are effective against deciduous species, but ineffective for conifers.


Kill in Per Cent
Concentration in Lb. Formulation Per 100 Gal. Water
Sodium TCA + D-T
Sodium TCA
Treated July 1956
Sodium TCA+SS
Treated Early May 1956
Sodium TCA + SS
Sodium TCA
D-T... 2,4-D—2,4,5-T (1:1) Used at 3 Lb/100 Gal
SS.... Surfactant (Spreader-Sticker) Used at 3-1/2 Fl Oz/100 Gal

RANGE OF EFFECTIVENESS varies with concentrations. Chemicals were applied during season of most active conifer growth (from late May through July)

Mobile Shoe Store Ups Safety Record

A shoe store on wheels helps reduce foot injuries for Cincinnati Gas & Electric Co personnel. Two well-stocked mobile vans, which visit all company operating locations twice a year, provide an on-the-job safety shoe purchasing service for Cincinnati Gas & Electric Co employees.

Safety officials made arrangements with a local industrial service company, operator of the vans, to have the shoe service cover all company locations in the 2,600 sq mi service area. The safety shoe promotion is done mostly at the start and end of work shifts. The truck visits company locations for one week each in the fall and spring.

Records show a decrease of almost 50% in the number of foot injuries since the program was started. Employees are enthusiastic over the program, which permits the safety shoes to be purchased on a company payroll deduction plan.

Economically

Differences in susceptibility of various species to control by chemicals became evident in the studies. Spruce is most resistant, followed closely by balsam fir. Any treatment that will control these two species appears to be effective for other problem species such as jack pine, white cedar and white pine. For all species, the smaller the tree the easier it is to kill.

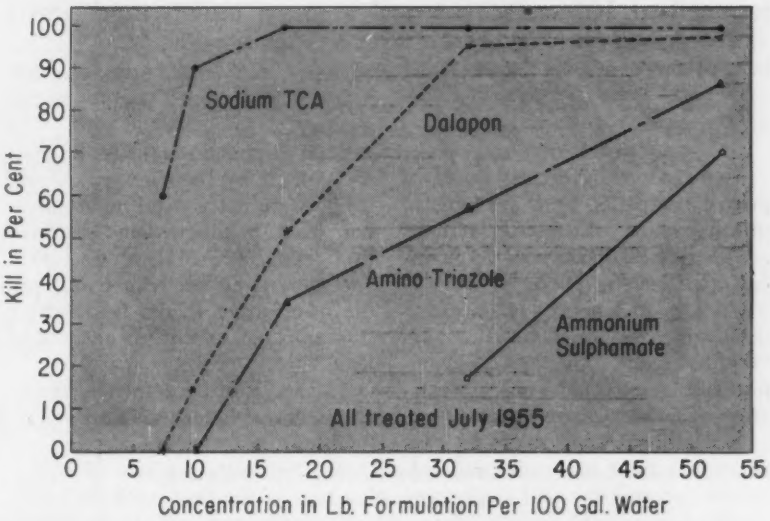
No fire hazard exists with TCA itself, and dead conifers on the right-of-way are no greater a potential hazard than if they were cut. Although TCA is a grass killer, only temporary and localized injury to grass results from the field use of TCA for conifer control.

There are, however, limitations to, and problems in the use of TCA. Results indicate that the applications are effective during the growing season only.

Corrosiveness to spray equipment also presents a problem. In a series of laboratory tests, solutions of TCA attacked magnesium and aluminum severely, and steel moderately. The use of protective coatings and frequent washings of equipment can minimize this. Formulations of TCA containing corrosion inhibitor may be obtained at a premium price; laboratory tests with such a formulation demonstrated that with the possible exception of magnesium, corrosion was satisfactorily inhibited in most cases.

Although relatively non-toxic to man and to warm-blooded animals, TCA is irritating to the skin and eyes, if used without caution.

Progress has been made in the study of aircraft applications of TCA, but a suitable procedure has not yet been established.



VALUE OF TCA can be enhanced by adding a surface-active agent. Combination with 2,4-D—2,4,5-T herbicides also increases the effectiveness of TCA

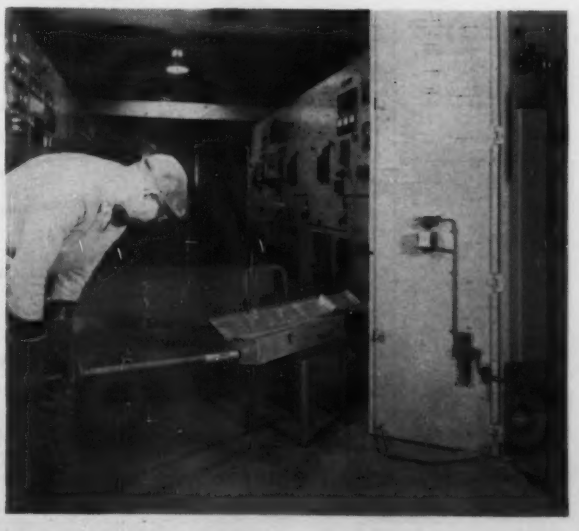
Potential Detector Checks Metalclad Circuits

W. P. TAYLOR, Senior Engineer, Electric Test Dept, Baltimore Gas & Electric Co, Baltimore, Md.

A dead circuit in metalclad switchgear, even adjacent to an energized circuit, may be positively indicated with a portable potential detector developed by Baltimore Gas & Electric Co. The detector is designed to avoid giving misleading indications as a result of stray fields.

Basic component of the detector is an AIRCO type R cartridge high-voltage indicator neon lamp in series with a metal tube (for capacity coupling) and mounted in a plastic tube. To reduce the sensitivity of this neon lamp, it is shunted by a 3-megohm resistor.

When not in use, the indicator is housed in an aluminum carrying case incorporating a built-in test device. The tester consists of a high-voltage ignition coil powered by two No. 6 dry cells in series and is equipped with a high-voltage gap and switches. Pushing the prod through a hole in the case closes the switch.



'No-Tap' Transformers Pay Off

"No-tap" transformers on Louisiana P&L distribution system sell at 10% discount and save on maintenance costs

H. L. DELONEY, Assistant Chief Engineer, Louisiana Power & Light Co, New Orleans, La.

"No-tap" transformers have a price incentive of 10% available to utilities whose distribution systems are already equipped with economical and reliable voltage control. Their use obviates many operating disadvantages associated with "tapped" units. On such distribution systems, the latter transformers offer no particular advantages.

All things considered, it appears that most users can find sufficient economic and operating justification to buy "no-tap" transformers in the most prevalent sizes in the single-phase class. The sizes include 50 kva and smaller and, as load densities increase, probably those of larger capacity.

Reduces Failures

Besides the 10% saving in first cost, the operation of "no-tap" transformers on a system with the proper supplementary voltage control affords these advantages:

1. It removes a major source of transformer failure—trouble in tap changers, tap leads, and reflection points in the tapped portion of the winding.

2. It eliminates transformer failure caused by moisture. Exposure to moisture entry is no longer present once handholes and external tap changers are dispensed with, and there is no need for going into the transformer in the field, where it is possible to disturb cover gaskets, etc.

3. Design of a completely sealed transformer becomes more practicable.

4. The costly practice of changing taps in the field, with its barely satisfactory results, can be abandoned. Two changes a year, one up and one down, at, say, $2.50 per operation could amount to 25 to 50% of the annual fixed charges on capital value of some smaller transformers.

5. Higher voltage at heavy load brings in more revenue.

6. Circuit and equipment capacities can be used to the maximum.

7. It eliminates area "zoning" of taps to compensate for supply circuit normal voltage drop. Although not necessarily recurring, "zoning" presents a problem when a utility cuts in new supply circuits or substations.

8. It permits switching of supply circuits from one area to another with a minimum of voltage disturbance—an important capability when alternative or loop feeders are involved.

9. There are no customer complaints arising from the misapplication of taps. High voltage is often a sequel to installation personnel failing to check a tap position. High-voltage complaints occur also when operating personnel neglect to restore taps to their original position after raising them as a temporary expedient during overload conditions or fail to adjust taps after cutting in new facilities, such as circuits, substations, voltage regulators, etc., all of which affect prevailing voltage levels.

Of the above advantages from the use of "no-tap" transformers, some are incidental solely to the supplementary voltage control; others to the combination of voltage control and "no-tap" transformers.

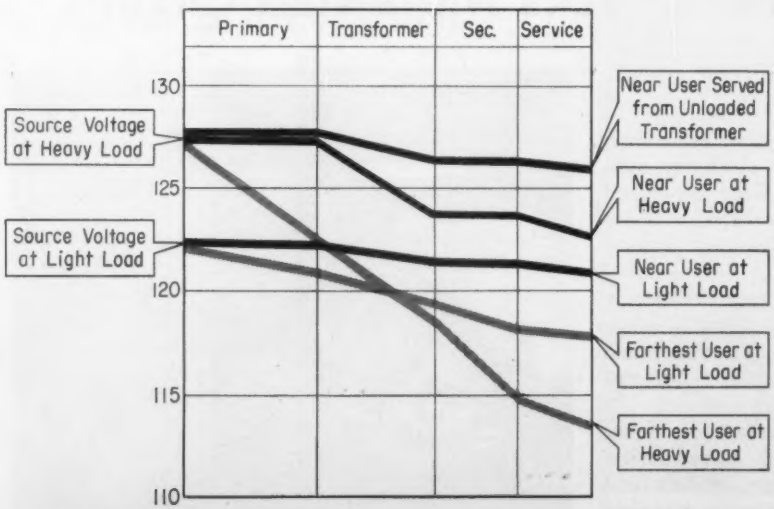
Two Classes Popular

Analysis of transformer manufacturers' records indicates a very definite trend to the use of "no-tap" units in the single-phase varieties, 50 kva and smaller. This is particularly the case with 2,400 and 4,800-v classes, where purchases of "no-tap" transformers now represent about 70 and 100%, respectively, of total purchases. "No-tap" transformers in these voltage classes enjoyed a 5% price advantage over transformers with taps for many years. This price differential has now been widened to 10%.

Until recently, "no-tap" transformers in the higher-voltage classes had no such price advantage. Before 1956 the 7,200-v class and before 1957 the 7,620 and 8,000-v classes were available only as "tapped" transformers as standard. The "no-tap" transformer, as a variation from the standard, carried a 5% penalty instead of a discount.

Several years ago a good num-

(*Continued on page* 80)



TYPICAL VOLTAGE PROFILE of a distribution circuit shows regulator output to user, positive compensation, higher and lower voltages at heavy and light loads

ANOTHER GENERAL ELECTRIC **Kilovar Plus...**

NEW Factory-Assembled Housed Capacitor Equipment

- Permits Expansion in the Field
- Costs Less Per Kilovar
- Allows Quick, Easy Installation

EXPANSION IN THE FIELD to keep pace with your load growth is now possible, using General Electric's new factory-assembled high-voltage housed capacitor equipment. Additional capacitor sections can be added in the field or included in the original equipment to bring the rating to 3600 kvar for a 5-kv-class equipment and 6000 kvar for 15-kv. A switch or breaker section is optional.

The basic equipment consists of one 1200-kvar capacitor section, with 50-kvar units, and a grounding device.

THE LOWER PRICE PER KILOVAR for this equipment has resulted from the use of 50-kvar capacitors and a more compact design, with a reduction as much as 10% under the cost of old-type apparatus with 25-kvar units.

INSTALLATION COSTS ARE LESS, because the equipment is shipped to you factory assembled with capacitors and fuses. The equipment is mounted on continuous base members, which can be used to skid the apparatus into place. Removable lifting eyes facilitate handling.

SIMPLIFIED INSPECTION AND MAINTENANCE are made possible by mounting the capacitors horizontally behind the housing doors. And because G-E capacitors have stainless-steel cases, they will never require protective repainting, another saving to you in time and costs.

FOR COMPLETE INFORMATION on General Electric's high-voltage housed capacitor equipment, write to Section 445-28, General Electric Co., Schenectady 5, N. Y.

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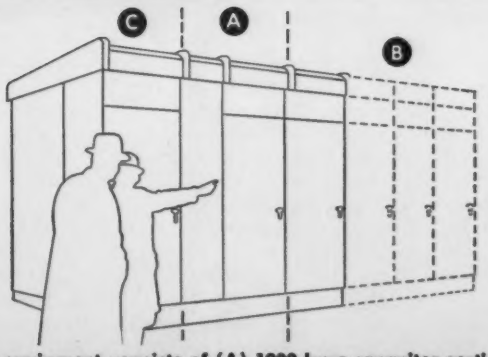
GENERAL ELECTRIC



Basic equipment consists of (A) 1200-kvar capacitor section and grounding device. Additional 1200-kvar sections (B) can be included in factory-assembled equipment, or added in field. Switch or breaker compartment (C) is optional.

THE MAN WHO HAS TO KNOW . . .
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'No-Tap' Transformers Pay Off (*Continued from page 76*)

ber of 7,620-v-class users, who had increased to represent a substantial volume of purchases, began asking for inclusion of a "no-tap" line in the standards. Their needs were recognized by the EEI-NEMA Joint Committee on Standards for Distribution Transformers. The committee recommended and obtained acceptance of the inclusion of "no-tap," 3 to 25-kva, 7,200-v transformers in the standards about March, 1956.

Polls of users eventually convinced the committee of the sufficient interest in "no-tap" transformers to warrant their inclusion in the standards. With this assurance, some manufacturers decided to produce "no-tap" transformers, 50 kva and below, at 7,620 and 8,000 v. These became available in 1957 at a price advantage of 5% over the units with taps. Manufacturers were able to reduce prices another 5% last June.

Spread Limited to 10%

Today voltage variations must be kept within a much narrower spread than was acceptable 10 or 20 years ago. Louisiana Power & Light Co's service standards specify that spread between the highest and lowest voltage supplied to customer of a given class shall not exceed 10% difference, and for any given customer shall not exceed 5%. On a 120-v basis, the range is from 114 to a 126 v, with only a 6-v spread allowable at any single customer's point of delivery.

To live within these established voltage limits, the company's studies indicate that the optimized system design peak load voltage drop limits for the various distribution system elements are about as tabulated.

The regulator, whether for bus or feeder re-regulation, is compensated to hold about 127 v at the time of heavy load. This limit prevents excessive voltage to the nearby customer who may be served from a lightly loaded transformer. The lower limit of about 122 v during minimum loads provides the desired median voltage of about 120 v to most customers.

Where feeders do not supply loads close to the substation, the upper limit of station regulator operation may be raised to obtain additional voltage drop allowable before re-regulation is needed. On some rural circuits, where customer density is so low as to prohibit the use of secondaries and transformers are sized above load requirements, it may be allowable to increase the primary drop to the re-regulation point or end of the primary to values above 5 v.

Today's distribution engineer has the tools for economical voltage control. They include: Step type regulators and under-load tap changers for station use; single-phase pole-type regulators for line use; primary capacitors for transmission and distribution station and line use; capacitor switching equipment; and, secondary capacitors. The proper use of these allows loading of transmission and distribution lines, transformers, secondaries, and services to their thermal or sometimes economic limit, instead of limitations set by voltage drop or regulation.

Bus regulation gives satisfactory operating voltage levels on circuits originating in major substations. These bus regulators are compensated either by line drop compensators or time-clocks control to hold 125 to 127 v at peak load conditions and about 122 v during minimum load conditions. Bus regulators also correct for voltage variations in the transmission system and the step-down transformers.

Beyond the about 5-v positive compensation at origin of distribution feeders, further regulation is not required on the various feeders until the point where combined effect of peak loading correction results in primary voltage drop approaching 5 v. Generally, where major substations are close to loads, 70 to 100% of station load is regulated adequately by the station bus regulators and switched capacitors.

Capacitors Justified

There remains, however, the need for re-regulating that portion of circuits where primary voltage drop falls outside the limit. Today's single-phase pole-type regulators do this job adequately and economically. Here, again, where more or less uniform load distribution is involved, Louisiana P&L must not allow more than 5 v (approx.) primary drop between regulators, or between the last regulator and the end of a line. Otherwise customers directly ahead of a regulator receive low voltage at the time of circuit peak. On long feeders this sometimes results in several regulator points in cascade.

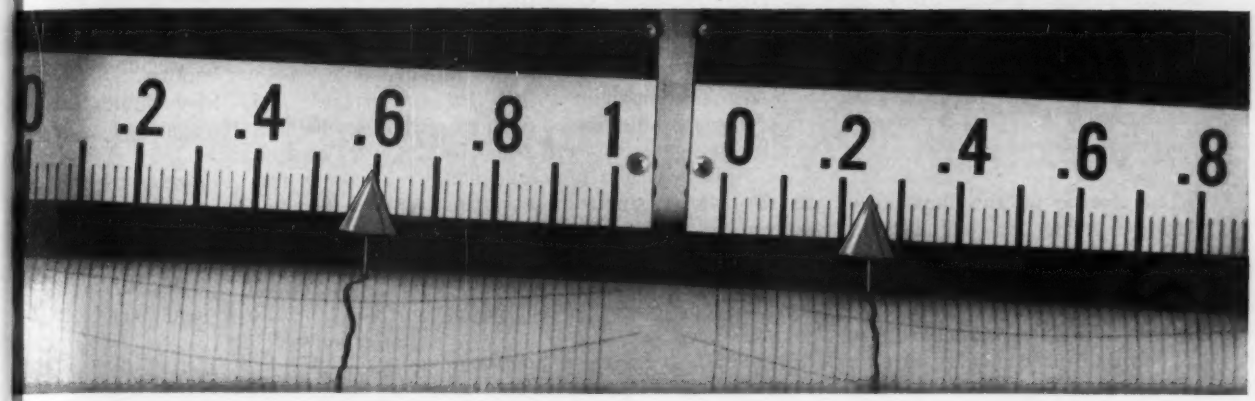
Capacitors are initially justified by two factors: the savings in system losses and the realization of maximum practical capacity utilization of generation, transmission, and distribution equipment. Properly applied, they are also an effective method of voltage control. Judicious placement of capacitor banks along primary distribution circuits allows correction of a large part of circuit voltage drop caused by load reactive requirements by automatic and seasonal manual switching of the banks.

Use of automatic regulators, in conjunction with seasonal manual switching of a large part of these banks, goes a long way toward elimination of automatic capacitor switching, although such switching remains a requirement in some instances.

Voltage Drop Allowed in Elements of Distribution System

	Volts	
	At Max. Load	At Min. Load
Distribution primary between regulating points or regulating points and end of primary	4.8	1.25
Transformer (160% rating)	4.0	1.0
Secondary	3.5	0.9
Service	1.2	0.3
Total	**13.5**	**3.45**

plots twin records . . .



This new General Electric Type CH-37 duplex recorder plots two complete electrical records side by side on one ten-inch-wide chart. No more reading separate charts . . . now related functions such as watts and vars, volts and frequency, d-c amperes and speed can be measured and recorded with 1% accuracy on ***one strip chart.*** The CH-37 saves valuable panel space . . . it's only 15 inches wide by $16\frac{1}{16}$ inches high and semi-flush mounted. It features ***throw-away inkwell,*** multiple chart speeds, chart supply indicator, fluorescent-lighted chart face and gasket-sealed door with key lock. Companion models include a new narrow-range CH frequency recorder, self-contained and with accuracy of ±.05 cycles and range of only 58–62 cycles . . . and the CH-7 hook-on volt-ammeter, for accurate recording of dip and peaks on exacting maintenance jobs. Get the complete story on General Electric's line of CH recorders. Just call your nearby G-E Apparatus Sales Engineer or write direct to Section 592–201, General Electric Company, Schenectady 5, N. Y.

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GENERAL ELECTRIC

240/480-V Urged for New Homes

Single-phase 240/480-v service proves most acceptable and economical for utilities and their high-use customers

F. A. COX, Commercial Manager, Chicago-South Division, Commonwealth Edison Co, Chicago, Ill.

The electric utilities must again plan for greater residential loads. And in their planning they will look to higher service voltage as the logical application of the method which has proved practical and economical for boosting the capability of other system components. Lack of an acceptable standard for this higher residential voltage has prompted numerous proposals. But the 240/480-v single-phase system would be the most acceptable and economical for utilities and their customers where demands exceed the capability of the 120/240-v service provided by present standards.

For New Homes First

Initial application of 240/480-v service should be for new homes in new subdivisions to serve large single-phase loads. Such loads would include central air conditioning installations, space heaters, pumps, and large appliances. Circuit runs in large ranch-type homes and on the farm, and the insistent demand for larger appliances without troublesome starting flicker, add incentive for use of the higher voltage.

Safety and electrical code considerations will probably confine use of 240-v-to-ground service to fixed appliances considered part of the house. Lighting and small appliances will still require 120-v service, provided by auto-transformers at the service entrance. These transformers, as part of the entrance wiring, should pose no major problems.

Whether the transformers will be furnished by the utility or by the customer is a matter of individual company policy. They must be made part of the service entrance wiring, bridging the transition to higher secondary voltage systems. They are the only practical solution to the problem of using existing 120-v appliances, particularly when customers move from one to another location.

When a companion system for supplying small distributed commercial loads is called for, the 240/416 Y-v, 3-phase system is practicable, the 240/480-v, single-phase system converting readily to this 3-phase voltage level.

In nearly all sections of the country, the 265/460 Y-v, 3-phase system has been installed to serve office buildings, high-rise apartment buildings, shopping centers, and industrial loads. Large spot and secondary networks have been placed in service at this voltage, indicating that the 120/208-v level is too low and uneconomical for larger loads.

Equipment on Hand

As this has been going on for more than 20 years, the economic advantage of 265/460 Y-v supply to the larger loads is firmly established in the minds of architects, and consulting and industrial plant engineers.

Switchgear, load center units, etc., are catalogue items for this system, as they are the same 480-v equipment used in standard industrial practice. In fact, 265/460-v is an established service offered by 25 utilities, with upwards of 1-million kva of installed capacity operating at it.

Tests Show Virtues

All case studies, based on cost per kva of installed capacity, should show about 10% economic advantage of the 265/465 Y-v system. This economic advantage is due to the fact that 265/460-v delivers 11.8% more kva capacity at 20% lower losses.

And 265/460-v also provides adequate voltage for 3-phase, 440-v motors, particularly for applications which must develop high starting torque for elevators, pumps, air-conditioning compressors, etc. It also provides 480-v for supplying widely used 4:1 dry-type transformers serving 120/240-v loads from 480-v risers and secondary mains.

Generally, standards are adopted as a consequence of universal use. The 265/460 Y-v system has met this criterion. Its economic advantage and utilization of universally available 440-v motors, 480-v switchgear, and 265-v fluorescent lighting ballasts have gained wide industry acceptance.

As only few advocates of this voltage ever considered pressing manufacturers for 265-v equipment, it is expected that the manufacturers will continue to resist requests for additional equipment to operate at this voltage.

Will Find Place

The electrical industry, in looking ahead to greater and greater residential loads, needs guidance in considering new levels of voltage. It appears that the 240/480-v, single-phase system has enough economic advantages for its consideration as a future standard higher secondary voltage.

In the role of a suggested standard, the 240-v-to-ground system, with fixed appliances available to operate at this voltage, will win general acceptance.

Estimates Too Low on Radio Channel Needs

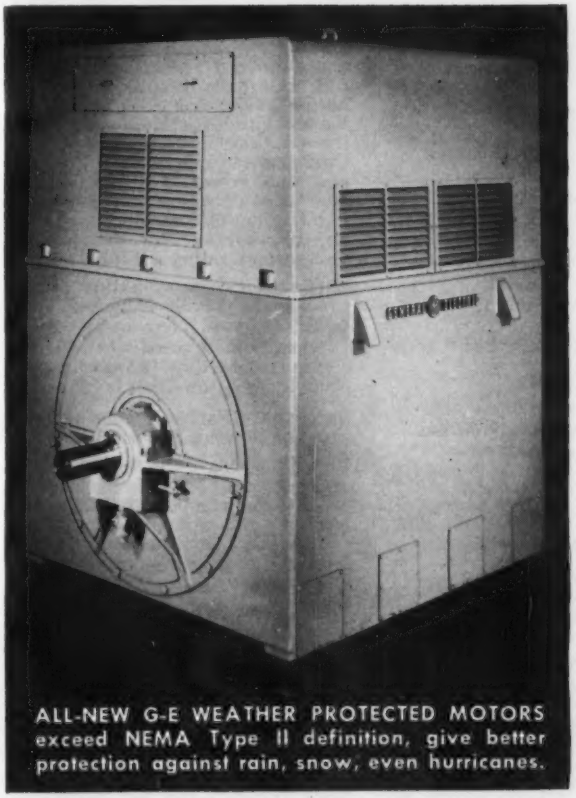
Written testimony submitted to the Federal Communications Commission has emphasized that previous estimates of utilities' 25 to 890-mc radio channel requirements have proved conservative. The testimony was prepared by the executive council of the National Committee for Utilities Radio.

The group included its estimates for requirements for the next ten years, based on a survey of U. S. utilities. During 1958, the group said, the number of microwave transmitters in the U. S. increased 41%. The number of electric utilities using microwave transmitters rose 16% during the same period.

An increasing difficulty "in finding interference-free mobile radio frequencies" was noted by NCUR, despite the FCC's new "split" channel frequencies and establishment of a local service for municipalities.

FROM GENERAL ELECTRIC . . .

New Custom-designed Power Station Motors Provide Better Protection, Easy Maintenance



ALL-NEW G-E WEATHER PROTECTED MOTORS exceed NEMA Type II definition, give better protection against rain, snow, even hurricanes.

Now, you can get a new General Electric motor custom-designed for your specific power station requirements. Nine custom-designed enclosures—eight custom-designed insulation systems—seven custom-designed bearing and end shield constructions—more than 15 custom-designed accessories—and a countless number of electrical designs: these give our engineers freedom to create a power station motor that can meet your exact needs. General Electric's all-new weather protected motor, shown at left, is one example of how a motor can be custom-designed for its particular application.

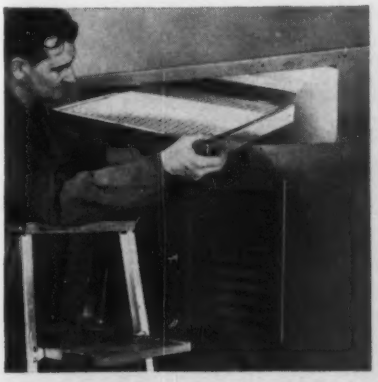
CUSTOM-DESIGNED FOR BETTER PROTECTION—Unique labyrinth baffling system of new weather-protected motor forces incoming air to make a series of right-angle turns and reductions in velocity before entering motor. And, special "blow-through" passages give extra protection against high-velocity winds.

CUSTOM-DESIGNED FOR EASY MAINTENANCE—New end shield is lightweight, easy to remove and disassemble, eliminating need for crane or lifting rig. Vistamatic sight gages are located on top and both sides allowing oil ring observation and easy reading of oil level.

CUSTOM-DESIGNED FOR GREATER ACCESSIBILITY—Removable top section provides access to all air passages and baffles for easy inspection, maintenance. Motor windings and bearings are easy to reach because of new end shield which is lightweight and easily removed.

FOR MORE INFORMATION on General Electric custom-designed power station motors, contact your nearby G-E Apparatus Sales Office or write to Section 884-1, General Electric Co., Schenectady, N.Y.

GENERAL ELECTRIC



TOP ACCESSIBILITY—Air passages in top section are completely accessible through nine openings. Filter installation or inspection is fast and easy.

BETTER PROTECTED AIR OPENINGS—"High up" air intake passages of new G-E motor prevent snow, trash, dust or dirt from being drawn into the motor.

SIMPLIFIED MAINTENANCE—Removable, lightweight end shield permits complete accessibility to motor interior, bearings without disturbing alignment.

how to coordinate SMD Power Fuses for maximum protection

a case study using a new "step-by-step" technique

A common error in fusing the primary of a power transformer is the selection of a fuse of such a speed and ampere rating that the full protection capability of the modern fuse is not put to use.

Properly selected, a modern power fuse can provide for

1. system protection,
2. transformer protection against secondary faults, even line-to-ground,
3. use of transformer short-time daily overload capability,
4. use of transformer short-time emergency overload capability, and
5. complete and precise coordination with other overcurrent devices.

The selection of the right fuse, however, has not been easy, since there has been until now no commonly and consistently agreed upon method of coordination; and only meager information about fuse performance has been available.

Consequently, a new "step-by-step" method for power fuse coordination has been developed by S&C. Supported with all necessary power fuse performance data, this method utilizes the full protection capability of the *modern* power fuse; furthermore, it lends itself to general acceptance and universal use because its development was based on the realistic recognition of

1. the duties the user desires to impose today on a power fuse, and
2. the contradictions in power fuse selection work—the need for simplicity on the one hand and the need for precision on the other.

The case study which follows illustrates the new step-by-step method. It concerns the selection, specifically, of the proper SMD Fuse Unit for application on a power transformer primary.

• • • •

Case Data:

Transformer Bank:
7500 kva, 3-phase, self-cooled.
Primary voltage: 69 kv delta
Secondary voltage: 7.2/12.47 kv wye
Short Circuit Maximum:
Primary: 750,000 kva
Secondary: 80,000 kva (bus fault)

Secondary Breaker:
Ampere Rating: 1200
Reclosing Time: 10-40-100 sec.
Relay-breaker characteristic shown by curve, Figures D and G

Procedure:

Using the S&C Data Bulletin 262, open the front cover to the step-by-step outline shown in Fig. A.

Step 1: Select voltage rating of fuse to equal or to exceed line-to-line voltage of the system—69 kv.

Step 2: Check for adequate interrupting rating (Fig. B). Since the maximum available short-circuit is 750,000 kva, the correct fuse unit is SMD-2.

Step 3: Establish the minimum ampere rating of the fuse unit. In this case use the table for self-cooled or water-cooled power transformers (Fig. C). *(Similar tables are provided for forced-air-cooled power transformers and for potential and distribution transformers.)* The fuse unit ratings in this table have been selected to carry normal short-time daily overloads of the magnitudes established by ASA in the publication, "Guide for Loading Oil-Immersed Distribution Transformers and Power Transformers." No *additional* allowance need be made. Per Fig. C under the proper voltage (69 kv) and proper kva (7500), the correct fuse unit ampere rating is 100E.

Step 4: Check coordination. Here are two ways: (1) Rule-of-Thumb Method (satisfactory in most cases) and (2) Precise Method (used when the Rule-of-Thumb Method apparently indicates that coordination is impossible).

SECONDARY FAULTS—RULE-OF-THUMB METHOD, FIGURE D.

First: Establish the fault conditions under which coordination is to be checked and compute the fault current levels. In this example, a 3-phase secondary bus fault is assumed, resulting in a primary fault current of 680 amperes (see ① in Fig. D).

Second: At this fault current level, read from the time-current characteristic curve the minimum melting time for this fuse unit, 100E amperes—Standard Speed assumed. This gives Point ② in Fig. D of 0.49 seconds.

Third: Multiply this time by .55—giving 0.27 seconds—thus establishing Point ③, the allowable minimum margin between fuse and breaker-relay curves. The factor .55 makes allowances for variations in ambient temperature and for full preloading of the fuse,

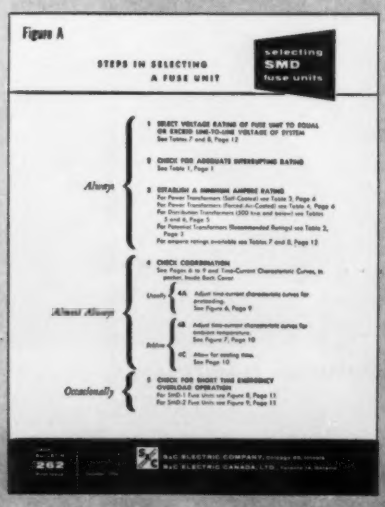


Figure A

STEPS IN SELECTING A FUSE UNIT

selecting SMD fuse units

Always

1 SELECT VOLTAGE RATING OF FUSE UNIT TO EQUAL OR EXCEED LINE-TO-LINE VOLTAGE OF SYSTEM
See Tables 7 and 8, Page 12

2 CHECK FOR ADEQUATE INTERRUPTING RATING
See Table 1, Page 3

3 ESTABLISH A MINIMUM AMPERE RATING
For Power Transformers (Self-Cooled) see Table 3, Page 4
For Power Transformers (Forced Air-Cooled) see Table 4, Page 4
For Distribution Transformers (300 kva and below) see Tables 5 and 6, Page 5
For Potential Transformers Recommended Ratings) see Table 2, Page 3
For ampere ratings available see Tables 7 and 8, Page 12

Almost Always

4 CHECK COORDINATION
See Pages 6 to 9 and Time-Current Characteristic Curves, in pocket inside Back Cover

Usually

4A Adjust time-current characteristic curves for prestarting.
See Figure 6, Page 9

Seldom

4B Adjust time-current characteristic curves for ambient temperature.
See Figure 7, Page 10

4C Allow for starting inrush.
See Page 10

Occasionally

5 CHECK FOR SHORT TIME EMERGENCY OVERLOAD OPERATION
For SMD-1 Fuse Units see Figure 8, Page 11
For SMD-2 Fuse Units see Figure 9, Page 11

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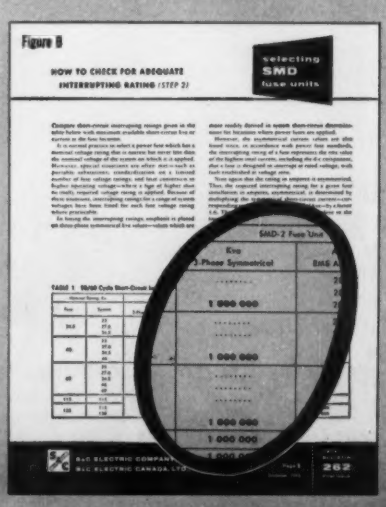
Figure B

HOW TO CHECK FOR ADEQUATE INTERRUPTING RATING (STEP 2)

selecting SMD fuse units

Compare short-circuit interrupting ratings given in the table below with maximum available short-circuit kva or current at the bus location.

It is normal practice to select a power fuse which has a nominal voltage rating that is nearest but never less than the nominal voltage of the system on which it is applied. However, special treatment will often be necessary when the system voltage exceeds the fuse unit's nominal voltage rating, and local experience or higher operating voltage—which is a type of higher duty—will require a higher voltage rating is applied. Because of these treatment, interrupting ratings for a range of system voltages have been fixed for each fuse voltage rating where practicable.

In forming the interrupting ratings, emphasis is placed on three-phase symmetrical line values—which are more readily derived in most short-circuit determinations for locations where power fuses are applied.

However, the symmetrical current values are also listed since, in accordance with power fuse standards, the interrupting rating of a fuse represents the rms value of the highest current available, including the d-c component, that such a fuse is designed to interrupt at rated voltage, with the recovery voltage at rated voltage.

Time upon the fuse rating in amperes is enumerated. Thus, the required interrupting rating for a given fuse installation in amperes, symmetrical, is determined by multiplying the system short-circuit current—corresponding to the desired time—by a factor taken from the table.

SMD-2 Fuse Unit

Kva 3 Phase Symmetrical	SMD-A
1 000 000	
1 000 000	
1 000 000	
1 000 000	

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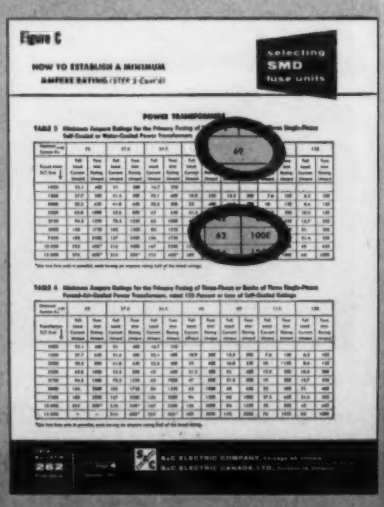
Figure C

HOW TO ESTABLISH A MINIMUM AMPERE RATING (STEP 3 Cont'd)

selecting SMD fuse units

POWER TRANSFORMERS

TABLE 3 Minimum Ampere Ratings for the Primary Fusing of Three-Phase or Banks of Three Single-Phase Self-Cooled or Water-Cooled Power Transformers

Transformer Self-Cooled kva	23 Full Load Current	23 Fuse Unit Rating	34.5 Full Load Current	34.5 Fuse Unit Rating	46 Full Load Current	46 Fuse Unit Rating	69 Full Load Current	69 Fuse Unit Rating	115 Full Load Current	115 Fuse Unit Rating	138 Full Load Current	138 Fuse Unit Rating
1000	25.1	40E	16	25E	12.5	20E	8.4	15E	5.0	8K	4.2	8K
1500	37.7	65E	24.4	40E	18.9	32E	12.5	20E	7.6	12E	6.3	12E
2000	50.3	80E	31.4	50E	25.2	40E	16	25E	10.0	15E	8.4	15E
2500	62.8	100E	39.5	65E	31.5	50E	20.2	32E	12.5	20E	10.5	20E
3750	94.2	140E	59.5	100E	47	80E	30.2	50E	18.9	32E	15.7	25E
5000	126	200E	79.5	140E	63	100E	40.5	65E	25.2	40E	21	30E
7500	188	280E	119	200E	94	140E	60.5	100E	37.5	65E	31.5	50E
10 000	251	400E	159	250E	126	200E	81	140E	50	80E	42	65E
12 000	302	450E	191	300E	151	250E	97	150E	60	100E	50	80E
15 000	376	600E	239	400E	189	300E	121	200E	75	125E	63	100E

TABLE 4 Minimum Ampere Ratings for the Primary Fusing of Three-Phase or Banks of Three Single-Phase Forced-Air-Cooled Power Transformers, rated 133 Percent or Less of Self-Cooled Ratings

Transformer Self-Cooled kva	23 Full Load Current	23 Fuse Unit Rating	34.5 Full Load Current	34.5 Fuse Unit Rating	46 Full Load Current	46 Fuse Unit Rating	69 Full Load Current	69 Fuse Unit Rating	115 Full Load Current	115 Fuse Unit Rating	138 Full Load Current	138 Fuse Unit Rating
1333	33.5	65E	21.5	40E	16.8	25E	11.2	20E	6.7	12E	5.6	10E
2000	50.3	80E	31.4	50E	25.2	40E	16.8	25E	10.0	15E	8.4	15E
2666	67.2	100E	43.2	65E	33.5	50E	21	30E	13.3	20E	11.2	20E
3333	83.8	140E	53.8	80E	42	65E	28.2	40E	16.8	25E	14.0	25E
5000	126	200E	79.5	140E	63	100E	42	65E	25.2	40E	21	30E
6666	168	250E	106	150E	84	125E	56	80E	33.5	50E	28	40E
10 000	251	400E	159	250E	126	200E	84	140E	50	80E	42	65E
13 333	335	500E	212	300E	168	250E	112	175E	67	100E	56	80E
16 666	419	600E	265	400E	210	300E	140	200E	84	140E	70	100E

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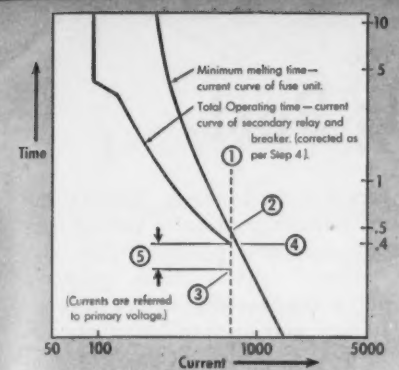
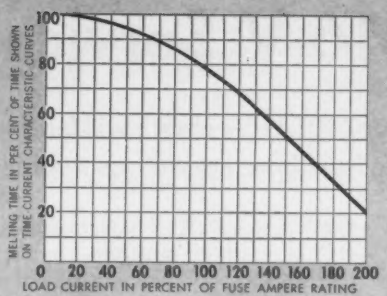


Figure D. Coordination by THE RULE-OF-THUMB METHOD — Secondary Faults


MELTING TIME IN PER CENT OF TIME SHOWN ON TIME-CURRENT CHARACTERISTIC CURVES
100
80
60
40
20
0 20 40 60 80 100 120 140 160 180 200
LOAD CURRENT IN PERCENT OF FUSE AMPERE RATING
Figure E. Preloading Adjustment Factors — Standard and Slow Speeds

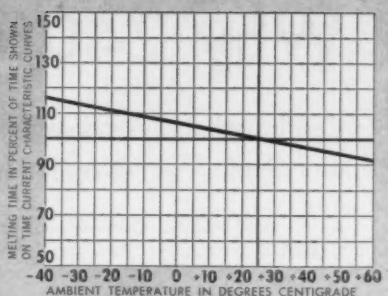


Figure F. Ambient Temperature Adjustment Factors

even from daily overloading of the transformer bank.

Fourth: Read from total operating time-current characteristic curve of secondary relay-and-breaker the operating time, Point ④, for this current level—0.40 seconds.

Conclusion: Coordination is not obtained since the time of Point ④ exceeds that of Point ③ by the amount shown at Point ⑤.

The next step is to recheck coordination, assuming a *Slow Speed* 100E ampere fuse unit. Here again, using the Rule-of-Thumb Method, coordination is not obtained. At this point, rather than to select a higher ampere rating which would sacrifice transformer protection, recheck coordination by the Precise Method.

SECONDARY FAULTS—PRECISE METHOD (an alternate to the Rule-of-Thumb Method), FIGURE G.

This method involves a comparison of the time-current characteristic curves of the selected fuse unit and the secondary breaker-and-relay *after both curves have been corrected* for the various factors that affect coordination. (See Fig. G below.) Factors for correcting relay and breaker curves are obtained from relay and breaker manufacturers.

The factors which apply to the fuse units are discussed below. They are:

- Adjustment for Preloading (see Fig. E above)
- Adjustment for Ambient Temperature (see Fig. F above)
- Allowance for the effect of cumulative heating and cooling of the fuse element during successive breaker operations (heating while short-circuit current flows, then cooling between breaker operations). Where the open-circuit time interval is less than ½ second, no allowance for cooling of the element is necessary; where the interval is 2 seconds or more (as it is in this case), the element will cool to a degree where cumulative heating need not be considered. (For intervals between ½ and 2 seconds, the full details on cooling time allowances are found in Data Bulletin 262.)

In this particular fusing problem, coordination with the secondary breaker-and-relay has been obtained by the Precise Method, since, in Fig. G, the time ② on the corrected fuse curve is greater than the total relay-breaker time ③ for this current level. This difference is indicated by ④. Were this not the case, using a Standard Speed Fuse unit, then a recheck would be made, using a fuse unit of the same ampere rating but Slow Speed. Do this rather than going to a higher ampere rating, since a higher rated fuse unit offers less protection to the transformer. If the Slow Speed does not coordinate satisfactorily, *then* recheck, using the next higher ampere rating in the Standard Speed.

PRIMARY FAULTS, FIGURE H.

For both Rule-of-Thumb and Precise Coordination Methods the same practice is used. No adjustments or margins are required. Coordination at fault level ① will be obtained where the total clearing time of the fuse unit ③ is equal to or less than the tripping time ② of the line breaker relay. ④ Indicates margin.

Step 5: Check for Short-Time Emergency Overload Operation.

These curves (Fig. I) show the ability of an SMD Fuse Unit to carry emergency overloads after carrying rated load. This overload situation arises, for example, when one transformer on a duplex substation is out of service for repairs or maintenance, putting the entire load on the other transformer and its fuses. The curves are based on an ambient of 30°C and represent the maximum *nonrepetitive* overload (in per cent of ampere rating) that an SMD Fuse Unit can carry for a given time without impairing its ability to perform properly. For each degree above or below 30°C, the capability may be adjusted 0.3 per cent.

• • • •

The above case study is a brief summary of a fusing problem solved by using the complete 12-page Data Bulletin 262 entitled, "Selecting SMD Fuse Units," published by S&C Electric Company. This bulletin with 8 Time-Current Characteristic Curves and a comprehensive text on coordination is yours for the asking.

S&C Electric Company, 4421 Ravenswood Avenue, Chicago 40, Ill. In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 14, Ontario.

S&C ELECTRIC COMPANY

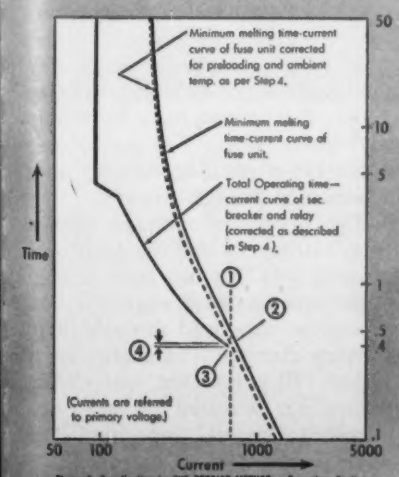


Figure G. Coordination by THE PRECISE METHOD — Secondary Faults

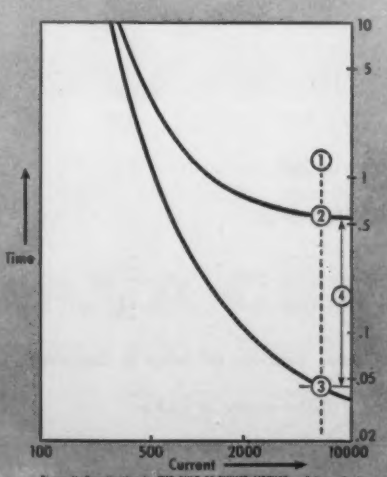


Figure H. Coordination by THE RULE-OF-THUMB METHOD — Primary Faults

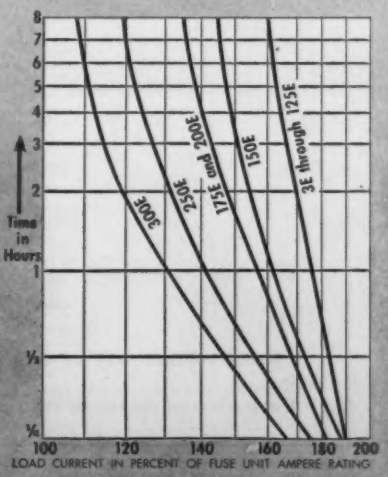


Figure I. Short Time Emergency Overload Capability — SMD-2 Fuse Units

Why 240/416-V Service Is Best

Continued analysis reveals that 240/416-v choice will lead to one simple 3-phase system free from inherent voltage troubles

A. S. **ANDERSON**, Electrical Engineer, Ebasco Services Inc., New York, N. Y.

Papers delivered at recent engineering society meetings urged utilities to adopt 240/416 v for general 3-phase service. But discussions of the proposal have brought forth factors interpreted as favoring 265/460 v. Because the electrical industry is approaching agreement on standards for higher-voltage utilization and secondary systems, these factors must be evaluated. It seems clear that:

1. Existing investment in 265/460 and 480-v delta systems should not deter a utility from accepting the 240/416-v system.

2. The 416-v system in the long run, should not result in split production, duplicate inventories, and confusion in application.

3. The 416-v system in the long 416-v motors would not lead inherently to voltage troubles and a long period of "creeping" to higher values.

The advantages of the 265/460-v system over 120/208 v led many utilities to offer it as an available service. In some cities nearly all large buildings erected in the last five years have the higher voltage. One large utility indicates a growth of 265/460-v systems at the rate of 80,000 kva per year; several have growth rates from 5,000 to 10,000 kva per year. Equipment is available and in some cases standardized nationally. Other standardization is in progress. The 265/460-v system has been accepted, and equipment for it has the price advantage of a standard system. It is no wonder, then, that some utility engineers have expressed the feeling that it is too late to consider another system.

But none of the existing 265/460-v systems needs to be changed if 240/416 v is adopted for future installations. Nearly all 265/460-v systems are spot installations serving single buildings that should continue in operation to the end of their normal life. Their existence will cause very little extra operating expense. Considering the benefits from future 240/416-v systems, the expenses connected with existing 265/460-v systems will be insignificant. Many utilities, which have large investments in the 265/460-v system, seeing the overriding advantages of the 240/416-v system, are willing to change to it when it becomes a standard. Recognizing the advantage of early standardization, they urge prompt action.

Many utilities have provided 480-v, 3-phase delta systems to consumers who operate 440-v motors. In most instances such systems will continue in service. But situations may arise where these systems are outgrown and some 440-v motors become available for application on 416-v systems. Past experience with 220-v motors on 208-v systems indicates that selective application should be usually practicable.

Adopting 240/416 as the higher utilization voltage offers much better promise of a universal system furnished by utilities. Consumers would benefit by using single-voltage-rated 3-phase motors. Utilities and residential and commercial consumers would find greater overall economy with the 240-v-to-neutral system, compared to mixtures of 120/208, 120/240 and 265/460-v systems. This mixture will continue if the 265/460-v system is adopted by utilities. But the 240/416-v system would serve 240-v single-phase equipment without additional transformation, and elimination of such transformation can be a strong incentive to conversions of 120-v equipment to 240-v service. Ultimately all single-phase equipment would be served at 240 v.

Contrary to what some utility engineers say, the 416-v system with 416-v motors will not be subject to voltage "creeping" to higher values or voltage troubles such as occur on the 208-v system serving 220-v motors.

There will be no compelling reasons for raising the 240/416-v level 5 or 10% as happened when 110 was boosted to 115 and then to 120 v. Neither will there be trouble with motor voltage, as general use of the 416-v motor is necessary after adoption of the 416-v system.

The history of voltage change from 110 to 120 and the possibility of going to 125 v has made a deep impression on some engineers and executives who lived through these creeping changes. The change from 110 to 120 v, however, was not arbitrary nor actuated by need for increased circuit capacity. The

Table I—Preferred Minimum and Maximum Service Voltage

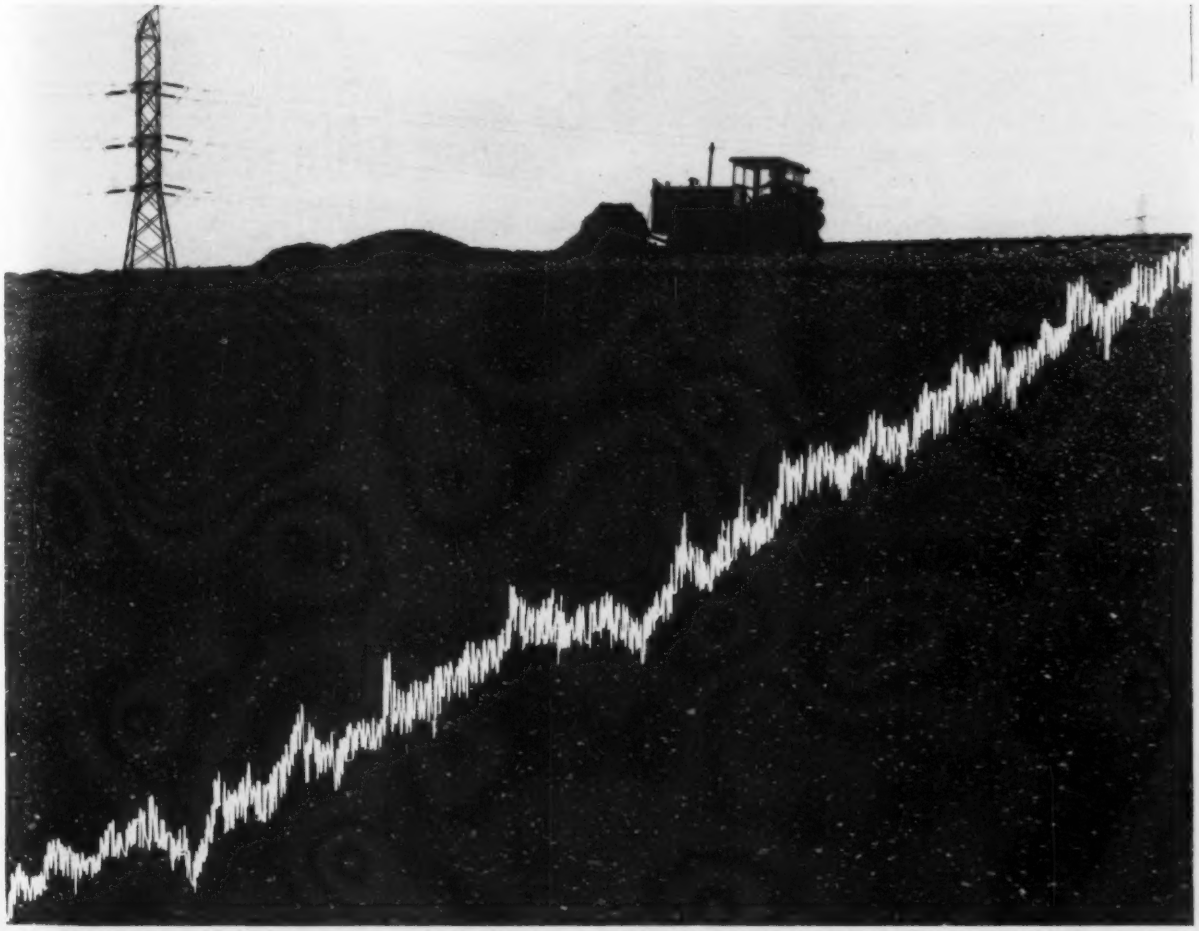
Secondary Connection	Nominal Voltage	Preferred Minimum (−5%)[1]	Preferred Maximum (+5%)
	120 V TO NEUTRAL BASE		
Wye	208	198	218
Delta	240	288	252
	125 V TO NEUTRAL BASE		
Wye	216	205	227
Delta	250	237.5	262.5

[1] Motor voltage may be 6 to 7 v lower because of drop in consumers wiring.

The preferred maximum voltage for a 220-v motor is 242 v.

powerful appetite!

As utilities *look* ahead and *build* ahead for a power demand in ten years double what it is today—continuity of supply and proven, available coal reserves are topmost subjects in discussions with their suppliers. A career coal company such as Island Creek with its vast reserves,* modern mining methods and scientific preparation facilities is in a position to come up with some very reassuring answers. We'd welcome an opportunity to do some looking ahead *with you.*



* *Island Creek's vast, proven, available reserves total more today than Island Creek has taken out of the earth in the past 50 years.*

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Table II—Preferred Ranges of Service Voltage and Motor Voltage

Item	Nominal	Minimum	Maximum	% Range
Delta System	480	456	504	± 5
Wye System	460*	437	483	± 5
Motor	440	396	484	±10
Wye System	416	395	437	± 5
Motor	416	374	458	±10

*Transformer secondary may be rated at 480 v. If this transformer is connected to primaries serving 120/240 or 120/208-v transformers it will be necessary to use a 4% up tap.

change to 115 v came when lighting and power transformers were kept separate yet connected to the same feeder. Low power factor and heavily loaded 3-phase secondaries required higher primary voltage than could be tolerated by 110-v lamps. Hence the need for 115-v lamps. Transformer banks were either single or 3-phase delta.

Introduction of the 4-wire wye network in the mid-20's initiated the move toward 120-v-to-neutral systems and 120-v lamps to insure satisfactory operation of 220-v motors. The industry was not inclined to standardize on the 208-v motor then, as it encountered relatively few cases of trouble with 220-v motors on underground network systems. But some companies learned through bitter experience that 120/208-v wye systems serving overhead radial street mains would not give satisfactory service to 220-v motors. Growing acceptance of refrigeration and air-conditioning, together with high-speed automatic elevators, boosted the demand for 208-v motors to where such motors were finally made standard. This came nearly 20 years after the first network systems.

Experience with "creeping" voltage or low-voltage troubles on 4-wire wye systems has convinced some utility engineers that the 265/460-v system is justified as a means of avoiding difficulties.

The change in lamp voltage from 110 to 120 v grew out of situations which will not exist at the higher level. Furthermore, there is no good reason to go to 125 v. Table I shows that as long as both delta and wye transformer connections are used, the 120-v level is preferable.

The preferred maximum for both delta systems is higher. But, situations requiring corrective measures on 120-v base systems have been few enough to be tolerable. Such would not be the case with 125-v-base systems.

The preferred minimum voltage for a 220-v motor is 198 v. This is so for a wye system on a 120-v base, and this low value caused trouble when the wye system was used on overhead systems.

Generally, utilities operate network systems to hold minimum service voltages above 95% so that 220-v motors usually operate successfully. But the desire to provide a higher range of voltage for 220-v motors gives rise to predictions that the nominal voltage will eventually become 125. A better solution, of course, is to use 208-v motors.

Higher voltage secondaries will be supplied often from primary circuits serving 120-v-to-neutral secondaries. Table II indicates the preferred maximum and minimum values of service voltage and maximum and minimum values within which satisfactory operation of motors is to be expected.

Table II brings out the following:

1. Generally, the 460-v system gives service voltages in the upper range of permissible motor voltage. If 277/480-v transformers are installed on the same primaries with 120-v base transformers, high voltages may be expected unless a 4% "up" tap is used.

2. The 416-v system provides a minimum service voltage approximately the same as the minimum permissible voltage for a 440-v motor. Allowing for a 3% drop in consumer wiring, the voltage is 3% less than the minimum limit for the motor. But, as has been proved in nearly 30 years of experience with 208-v systems and 220-v motors, selective applications can be made successfully.

3. The 416-v system provides a very desirable range of voltage for the 416-v motor. This motor can be expected to operate successfully and economically on any 416-v system, overhead or underground, radial or network.

Utilities Lose By Default (*Continued from page* 67)

circuit breakers on the 4.16 or 12.47-kv side, cuts costs and allows uprating of substation capacities, said J. L. Nolte, Union Electric Co. Maintenance costs were also reduced, and the breakers at the 34-kv source protect against transformers faults and faults on the low-voltage bus.

F. S. Dlouhy described Oklahoma G&E developments in the application of low-cost protective devices for reducing substation costs and switching large blocks of power. But some of the savings, he added, go into complicated relaying and preventive measures, such as two shield wires on transmission lines and other system-strengthening measures.

Kansas City P&L has redesigned its bill for five-dial meter billing, said J. R. Silver. A die-cutting machine accepts continuous form paper documents and cuts forms to punched-card size at the rate of 100 per min. Increasing energy use, along with a change to bi-monthly billing, which brought troubles from "turnover" of the four-dial meters, motivated the change, he said.

Random-sample testing of meters not only cuts testing costs some $10 million, but tends to improve metering itself, and said Floyd Busch, Hotpoint.

our 100th gas turbine now being built for MOORHEAD, MINN.

OVER 1,300,000 KW in total gas turbine capacity built or on order for industrial and utility applications, including 16 units in the United States, Puerto Rico and Canada with a maximum capacity of over 300,000 KW . . . *experience unmatched by any other manufacturer.*

PROVEN DEPENDABILITY AND ECONOMY of Brown Boveri gas turbines has been established in many years of operation in installations the world around, often under extremely adverse conditions.

STANDBY AND PEAKING POWER — The 7,400 KW Brown Boveri gas turbine (with a bonus wintertime capacity of up to 10,000 KW) purchased by the Moorhead municipal utility is tailormade for the city's peaking and standby requirements. Brown Boveri gas turbines offer many unique and proven advantages in this type of application.

POWER FACTOR CORRECTION using the generator as a synchronous condenser. A specially-developed coupling, exclusive with Brown Boveri, makes it possible to disconnect the generator from the turbine and reconnect it again at full speed whenever power generation is needed.

BASE LOAD OPERATION — Backed by a long record of engineering and production firsts, Brown Boveri gas turbines have been an unqualified success in many base load applications. And on the engineering horizon is the use of gas turbines in combination with steam cycles for even more efficient base load performance.

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Sangamo Type P Meters offer unusual economies with accurate measurement.

Available now for all polyphase loads. The meters start at 18 watts—operate continuously at 96,000 watts.

You can calibrate in half the time. There are up to four fewer adjustment points. In addition to micrometer power factor adjustment, the P2 Meter has only three adjustments—full load, light load, and balance.

You save money in glass covers. These meters are the only polyphase meters small enough to use your standard metal base singlephase meter covers.

You have greater surge protection. Current windings are encapsulated in high strength epoxy resin insulation. Both current and potential coils have breakdown in excess of a 15 KV surge.

You gain economy through slow speed. Reduced series damping and fewer revolutions just naturally mean greater accuracy and better performance.

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JM59-4

LIFETIME GUARANTEED SANGAMO TYPE P METERS FOR

Class 200 4 wire, 2 stator Delta

Class 200 4 wire, 2 stator Wye

Class 100 2 stator Network meter

POLYPHASE METERS

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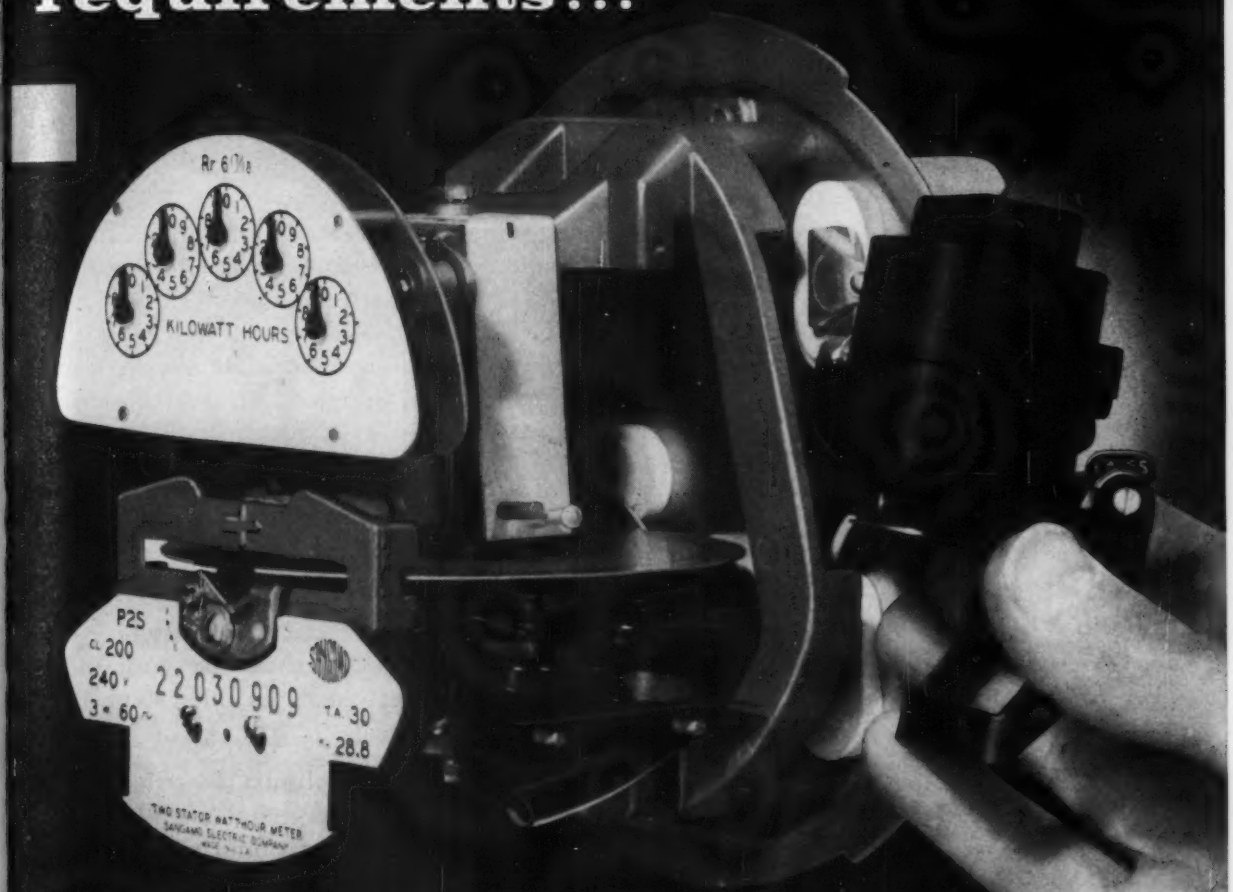
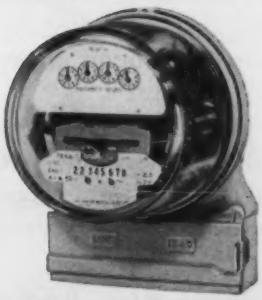


ALL POLYPHASE MEASUREMENT

Class 100 3 wire, 3 phase, 480 v.



Class 10 4 wire, 2 stator Delta

The potential coil can be removed and replaced without disassembling other components. *Replacement time is cut in half.*

60th ANNIVERSARY SANGAMO 1899-1959

Procurement & Products

FUEL PRICES ▶ **Proposed 50¢-per-ton reductions in coal freight rates** to North Atlantic ports ran into a snag last week as Empire State Petroleum Association, Inc, asked ICC to delay their effective date beyond May 15. The Association labeled the reductions "discriminatory" and indicated that, if they were allowed, residual oil prices would have to drop by 12½¢ a barrel to be competitive.

ICC could turn down the railroads' petition on this basis, but a more likely result is that the lower rates will go into effect on schedule, but "subject to investigation."

OUTLOOK ▶ **Industrial production forecasts are creeping upward.** Consultants to the Commerce Department's Business Advisory Council last week offered predictions for the second quarter ranging from 147 to 150 on the FRB's index. Predictions for second quarter 1960 ranged from a low of 152 to a high of 162. March index was 147.

COMMUNICATIONS ▶ **Large eastern electric utility is installing a facsimile set** for transmitting graphic and printed material over long or short distances. The set, marketed by Fairchild Camera & Instrument Corp, may be of use in certain stores and engineering operations. Recorders and scanners can be tied together by shortwave radio circuit, microwave, or telephone line. Recorder uses roll of receiving paper, making it possible to have unattended service.

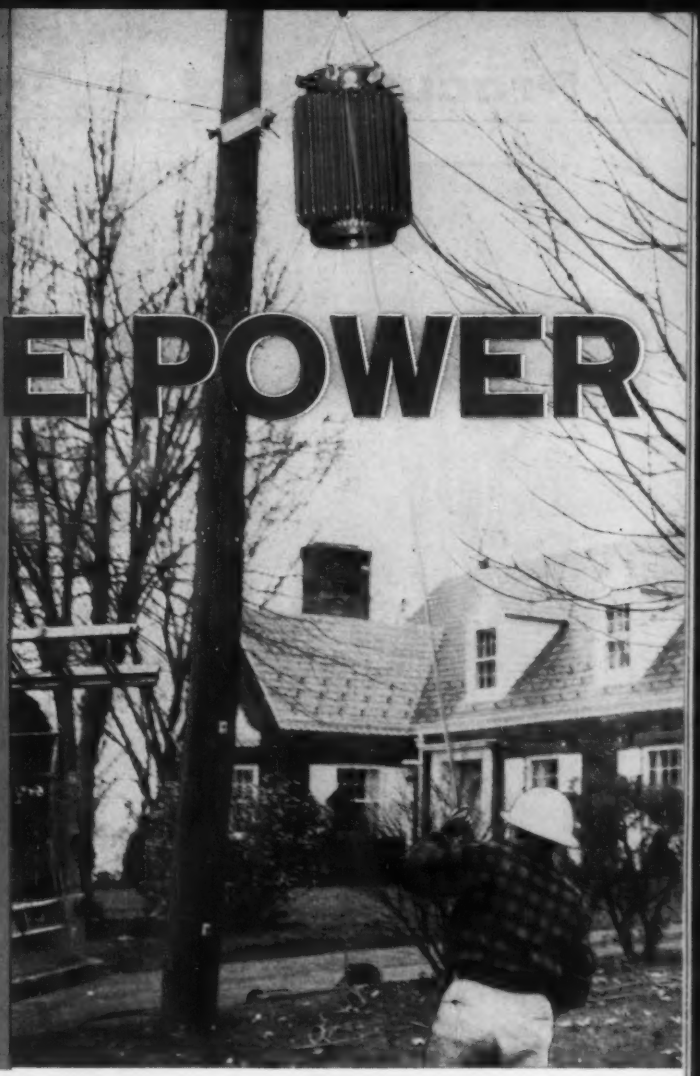
MANUFACTURERS ▶ **With acquisition of ACF Industries commercial reactor engineering office and staff,** Allis-Chalmers increases its competitive position in the power reactor field. ACF nuclear staff includes some 190 engineers, technicians, and others.

Alcoa and Kaiser are joining with Pennsylvania Electric Co in building an experimental 460 kv line. Three other manufacturers are already cooperating in the project. The two conductor fabricators will furnish approximately 728,000 lb of aluminum transmission cable for the tests in diameters from 2.32 down to 1.75 inches.

EQUIPMENT ▶ **New "crane" helicopter** designated "S-60" has been demonstrated by Sikorsky Aircraft Div, United Aircraft Corp. In first public showing, the plane lifted a two-ton utility pole and placed it in hole.

MEETING ▶ **Full report on EEI Purchasing & Stores meeting** will be carried in this space during next few weeks. Highlights will include value analysis, buying and stores cooperation, and evaluation of materials handling costs.

News of Manufacturers ..... page 94
New Equipment ..... page 101
Readers Service ..... page 106



You get more POLE POWER with Pennsylvania's new 250-kva featherweight POLE STAR TRANSFORMER

Costs 15% less than station-type transformer

In 1953, Pennsylvania pioneered "higher kva" pole-mounting by introducing the 167-kva Featherweight Pole Star—an innovation that soon led to a revision of industry standards. Now, Pennsylvania extends to 250 kva the operational and economic advantages of its Featherweight pole-type design.

The ability to put 250 kva on one pole with a single transformer permits utilities to satisfy increasing demands by replacing lower rated pole-type transformers and avoiding the added expense of platforms or vaults. If, on the other hand, a utility's operating practices preclude pole-mounting of 250-kva units, the 15% *lower cost* of the new Featherweight Pole Star can apply also to platform, ground pad or vault installations.

The smaller size, lighter weight and lower cost of the new 250-kva Featherweight Pole Star are accompanied by *overall improvements in electrical characteristics*. Compared to a 250-kva station-type unit, the new Pole Star has lower losses, greater efficiency at all load percentages, better regulation, lower exciting current, and lower impedance. It features the same ease-of-handling as its 167-kva forerunner.

Before your next 250-kva purchase—whether for pole-top or some other type of installation—it will pay you to consider the lower cost and other advantages of Pennsylvania's new 250-kva Featherweight Pole Star, available through 15 kv. Contact Pennsylvania Transformer Division, McGraw-Edison Company, Canonsburg, Pennsylvania.

A STATISTICAL COMPARISON

250-Kva Featherweight Pole Star vs. Station-type
(*Example:* Transformer rated 7200/12470Y—120/240 volts; with taps)

	Featherweight	Substation-type	% Smaller or Lighter
Overall Height	59 in.	81 in.	27.1%
Width	36¼ in.	37 in.	2.0%
Depth	31½ in.	46 in.	31.5%
Net Weight	1750 lbs.	3400 lbs.	48.5%

ALL ELECTRICAL CHARACTERISTICS HAVE BEEN IMPROVED COST REDUCED APPROXIMATELY 15%

PENNSYLVANIA DISTRIBUTION TRANSFORMERS

McGRAW EDISON

POLE STAR

Cable Coupler Makes 7.5-Kv Extension Cord

A new cable coupler now on the market makes it possible to put together a 7.5-kv extension cable.

The 50-lb coupler is already used in the mining industry to join 500-ft lengths of cable to form a safe 7.5-kv extension. The couplers are also used for connections on switchgear and transformers.

The insulation is believed to be a major factor in making the coupler safe for 7.5 kv. The device's plug and coupler are made of a moisture-resistant glass-reinforced plastic known as Glastic.

Glastic is said to have high-impact strength to withstand abuse when the coupler is dragged along the ground, and arc resistance to prevent arc tracking in case of overloading. The flame-retardant plastic also has dimensional stability to assure proper alignment between the plug and socket. In manufacturer tests, the Glastic withstood 35 kv ac and 60 kv dc without breakdown.

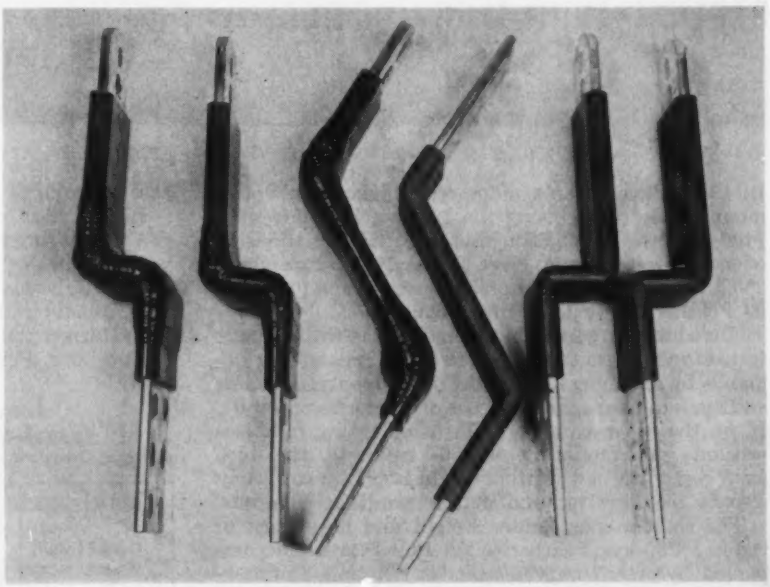
The coupler is made by PLM Products, Cleveland. Plug and socket are custom molded from fiber glass reinforced polyester by Glastic Corp, Cleveland.

New Insulation for Switchgear in Humid Areas

Federal Pacific Electric Co recently announced development of an improved material for use in fabricating bus bar insulation, bus supports and phase barriers in 5 and 15-kv metal-clad switchgear.

Designated Insul-glass, the new material is essentially a cast or molded glass-reinforced polyester. Federal Pacific says it combines "superior qualities of resistance to tracking and flame, high dielectric and impact strength, and extremely low power factor, moisture absorbency and corona loss levels."

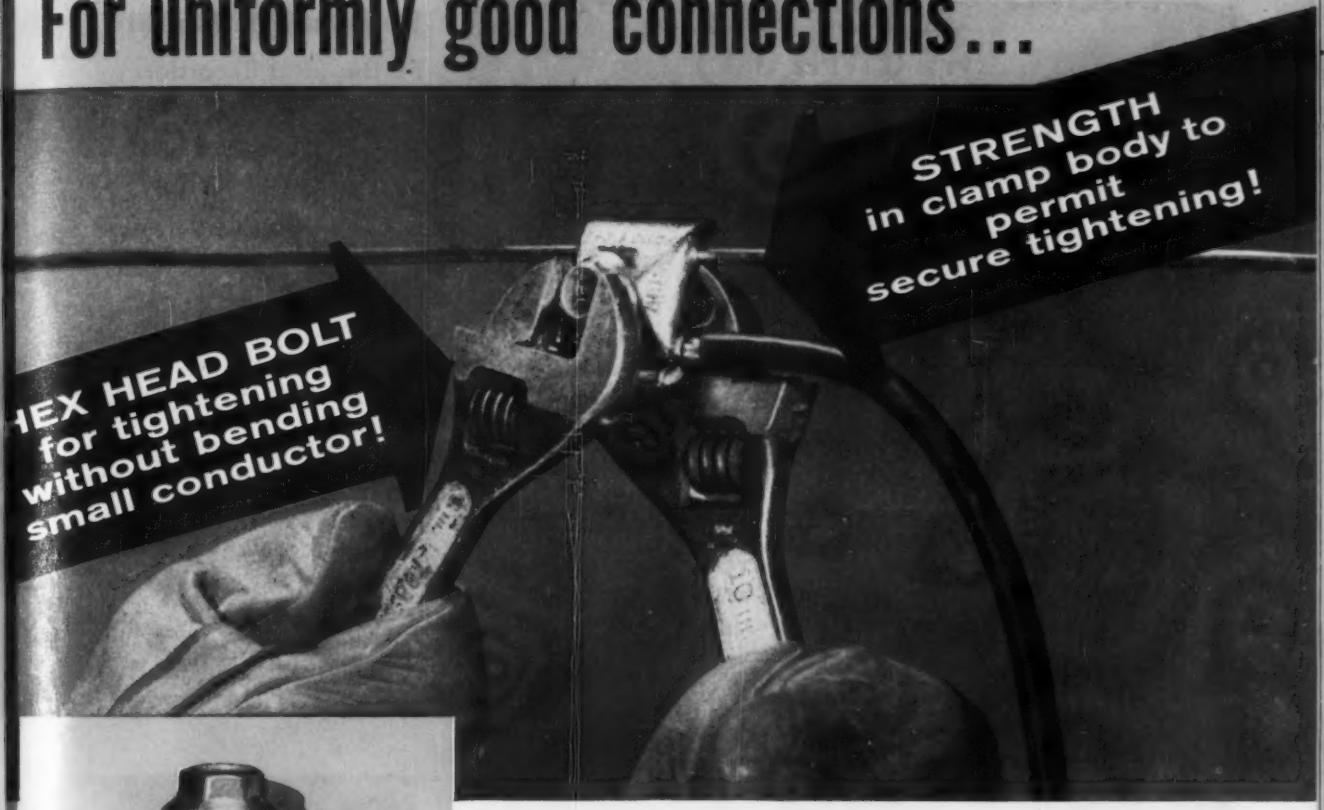
A further user advantage, the company points out, results from the method of applying the material to bus. Integral casting automatically assures a constant thickness of insulation and eliminates the need for manual wrapping of bends and offsets. Photo illustrates new method (right) of integral casting and old method of manual wrapping (left) which risked undetected voids.



Insul-glass was developed to meet the particular problems of utility and industrial customers with equipment in high humidity and contaminated air locations. Though present applications are only for 5 and 15-kv metal-clad switchgear, the company plans to extend the application of related polyester insulating materials to other distribution and control apparatus.

(*More Manufacturers News, p* 96)

For uniformly good connections...



Chance PG Clamps now have a steel hex head bolt so lineman can apply them with two wrenches, without distorting the conductor. Clamp bodies are extra strong in the areas where strength is important, yet have the proper resiliency to handle thermal movement. These clamps contact all outside conductor strands to give a good high conductivity connection.

...let your linemen install CHANCE PG CLAMPS

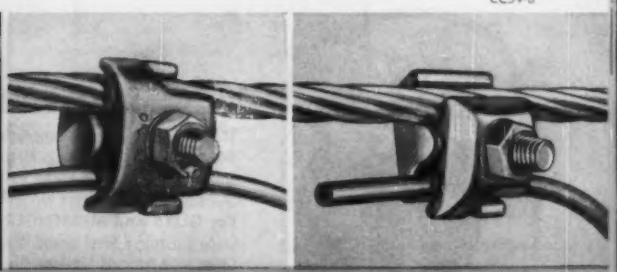
Your linemen will just naturally make uniformly good, troublefree connections when you supply them with Chance Parallel Groove Clamps. Hex head bolts and extra strength permit two-wrench application without clamp or conductor distortion. Packaged clamps eliminate the need for the lineman to apply contact aid to the clamp itself and a reminder tape on the package tells him to wire brush and apply contact aid to the conductor. All purpose AGP Clamps, when used on bimetal connections, eliminate checking to see which side has the copper insert ...you get a good connection either way.

They are available as shown for standard service, and in 2-bolt and 3-bolt types for heavy service connections.

CC59-8

Clamps are available in individual plastic packages with a.l.n. 100 Contact Aid pre-applied. Clamp stays clean—lineman is reminded to prepare conductor to protect your circuit. Package is easily opened with lineman's pliers.

Chance PG Clamps are engineered for quick, safe installation. Lineman can apply the Series 100 clamp without touching the conductor or bridging the gap between conductor and jumper with the hand.

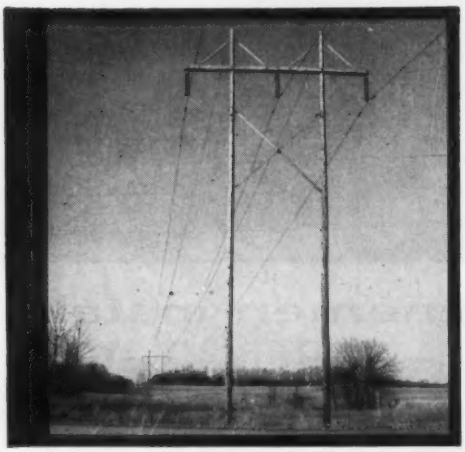


Two Designs—Two Types. PG 200 Series has fingers that interlock around main line and tap line. PG 100 has a wide jaw for the main line, interlocking fingers for the tap line. Type "AA" has uncoated aluminum body—"AGP" has heavy fortified cadmium coating for use with all conductor combinations.

A. B. CHANCE COMPANY CENTRALIA MISSOURI

A. B. Chance Co. of Canada, Ltd., Toronto

GALVANIZED STEEL STRAND

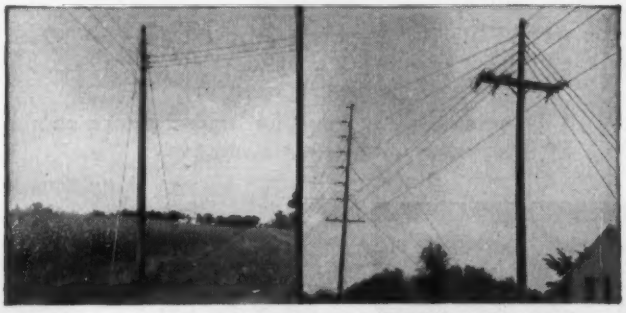


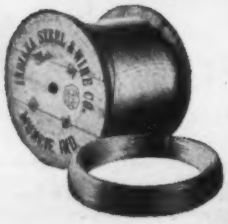
YOUR ASSURANCE OF HIGH QUALITY, LONG LIFE AND LOW COST

Close laboratory control over each step in manufacture has established Crapo Galvanized Steel Strand as a product of highest quality and dependability. You benefit through longer service life and lower ultimate costs.

Heavy, uniform, tightly-bonded coatings of commercially pure zinc, applied by the famous Crapo methods, withstand the punishment of construction, provide maximum resistance to corrosion and contribute to over-all economies.

For OVERHEAD GROUND WIRE . . .
CRAPO Weldless Galvanized Steel Strand





The most practical and economical strand for shielding transmission lines against lightning. Maximum strength and high fatigue endurance, inherent in Crapo Weldless Strand, provide that extra safety factor so important in overhead ground or static wire.

For GUYS and MESSENGER . . .
Crapo Galvanized Steel Strand. Made to highest standard specifications . . . a size and breaking strength to meet all practical needs.

Contact your jobber or write for descriptive folder.

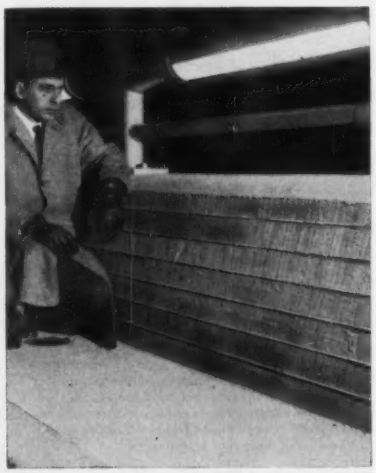
INDIANA STEEL & WIRE CO., INC.
Muncie, Indiana

Sangamo Will Market FP Demand Recorders

Sangamo Electric will sell Fischer & Porter punched-tape digital demand recorders and translating systems to the electric utility industry on an exclusive basis. The two companies recently announced this marketing agreement.

The recorders will round out Sangamo's line of demand metering equipment and provide the coordinated accuracy required in demand recording installations.

Two models of translators will be available: a simplified model for translating and identifying tape data; and a larger model incorporating all features that might be desired in tape translation. Tape translation analysis will also be available at nominal cost from Sangamo's factory at Springfield, Ill.



Waist-High Bridge Lighting Provides Greater Safety

Low-level lighting, installed by General Electric on the new Manahawkin Causeway Bridge in N. J., provides greater safety for motorists and easier servicing. The "waist-high" fluorescent lighting system is composed of 768 GE luminaires mounted in aluminum railings 50 inches above road surface at 2-ft intervals.

The low focus of light rays leaves the parapet in shadows, directing

(*Continued on page* 98)

Enjay Butyl is used in General Electric washers and refrigerators because it offers economy and outstanding all-round quality performance.

ENJAY BUTYL

helps make more efficient appliances!

General Electric uses gaskets and hoses made of Enjay Butyl in their new washers and refrigerators.

Enjay Butyl parts are highly resistant to heat... aging... moisture detergents, bleaches and other chemicals. As a result, equipment lasts longer, performs better.

Technicians constantly find new ways to use Enjay Butyl in a great variety of applications—*and at lower costs!* It will pay you to investigate the possibilities of this versatile rubber in *your* product. For full information and expert technical assistance, write or wire the Enjay Company.

ENJAY BUTYL

Enjay Butyl is the greatest rubber value in the world. It's the super-durable rubber with outstanding resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture.

Pioneer in Petrochemicals

ENJAY **ENJAY COMPANY, INC.,** 15 West 51st Street, New York 19, N.Y.

Akron • Boston • Charlotte • Chicago • Detroit • Los Angeles • New Orleans • Tulsa

The design work on all these new substations is going to be hard to handle with our present force.

Of course! They have enough to do handling routine duties. Why don't you call in PIONEER?

GIVE YOUR NON-ROUTINE OPERATIONS TO PIONEER

Design and Consulting Engineering Services

Pioneer has specialized in designing power plants for 57 years. It offers design service for fossil fuel, hydro and atomic plants. It will also assist in forecasting load growth, in site selection, in purchasing and expediting of equipment and in supervising construction. Pioneer's other services include substation, transmission and distribution studies and design.

Services in Regulatory Matters

Pioneer offers its services in all phases of Federal, State and Local regulation including the rate base, depreciation analysis, cost of service studies, market analysis, certificate proceedings and rate of return.

Corporate Services

Pioneer's services in corporate matters include business and management engineering advice, financial, accounting and tax counsel and insurance and pension plans and programming. It maintains a complete stock transfer, ledger and dividend disbursement service.

NEW! On your letterhead, write for 40-page booklet, "Pioneering New Horizons in Power". Describes, illustrates Pioneer's engineering services, and corporate services, from financing to operation.

57 YEARS

Pioneer Service & Engineering Co.

231 South La Salle Street
Chicago 4, Illinois

Waist-High Bridge Lighting

(*Continued from page* 98)

drivers' attention to the roadway. Light rays, beamed across the 4-lane roadway at right angles to traffic, eliminate glare. The lights are accessible for servicing from bridge walkways.

Tests conducted on the bridge as far back as 1954 validated the installation plan, an idea of the State Highway Commissioner.

MANUFACTURERS BRIEFS

Single-pole drawout is featured for 49 alumnium-clad, 6-pole, high-speed anode switchgear assemblies shipped by **I-T-E Circuit Breaker Co** to the new Reynolds Metals plant in Massena, N. Y. Any of the poles can be withdrawn or removed without interrupting power flow from the other five. The assemblies incorporate I-T-E's Type FB breakers to interrupt faults having a rise rate of 15 million amp per sec . . . **General Electric** has a new 20,000-sq-ft dc advanced engineering center in Philadelphia, where new designs in equipment and components for conversion of electric power by static means will be explored. A major project will be the development of silicon semiconductor and mercury-arc power equipment for use in highly regulated industrial power supplies.

Sylvania Electric Products has developed a theory in phosphor size control which, when combined with new manufacturing techniques, produces light output of 80 lumens-per-watt from a 40-watt fluorescent lamp. Particle size of phosphor is limited to a range of from 3 to 30 microns. . . . New fluorescent lamp, designed by **Westinghouse,** requires neither starter nor external ballast, and can be mounted in a single conventional screw base. A bi-metallic starting switch and an incandescent filament, both integrals of the lamp, preclude the necessity of using an auxiliary starter or external ballast. No plans have been made to market the lamp. Other applications are being determined . . . This year 29 engineers from various firms were graduated from **General Electric's** power systems course.

now M-S-A® Shockgard* Hats and Caps are safer than ever

Safest on the inside, safest on the outside. M-S-A Shockgard surpasses all E.E.I. Specifications.

New M-S-A Fixed-Crown* Suspension shields workers' heads with tamper-proof margin of extra safety

Testing at 15,000 and 20,000 volts assures optimum electrical resistance

A slip-in double cradle with the new M-S-A "Fixed-Crown" Suspension for the Shockgard provides a permanent 1½ inch clearance between the wearer's head and the inside top of the Shockgard.

This clearance is a life-saver in case a heavy object should fall on the hat. A fixed *upper* cradle (1) makes it tamper-proof. The easily adjustable *lower* cradle (2) may be fitted to the individual's head size for snug head comfort.

The new suspension is easy to insert, easy to remove. Pressure points have been eliminated. Size adjustments can be made with a simple collar button device. One-eighth head size units are stamped on the sweatband backing.

*Trademark

Tough, one-piece molded shell of both hat and cap models offers high resistance to impact and penetration. No metal parts. All fittings are plastic.

Electrical resistance tests—at the factory—at 15,000 volts for a full minute, prove the effectiveness of every Shockgard Hat and Cap. A breakdown test is run up to 20,000 volts. Voltage protection is unimpaired through temperature ranges of under −25° to over 200°F.

Available in yellow, orange, white or gray. Write for new bulletin. Mine Safety Appliances Company, Pittsburgh 8, Pennsylvania. In Canada: Mine Safety Appliances Company of Canada, Ltd., Toronto 4, Ontario.

Every day—in many ways—MSA products safeguard millions of lives

MSA®

why buy three?

WHEN WILL DO

THE HUBBARD

E H D

Look for this emblem. It is symbolic of the Hubbard EHD, the industry's first Single-Vent, Small-Bore Extra Heavy Duty Cutout—a single cutout that will provide positive and safe protection against all fault currents from the point of minimum fuse melting to the maximum rating of the EHD.

SINGLE VENT

EHD

SMALL BORE

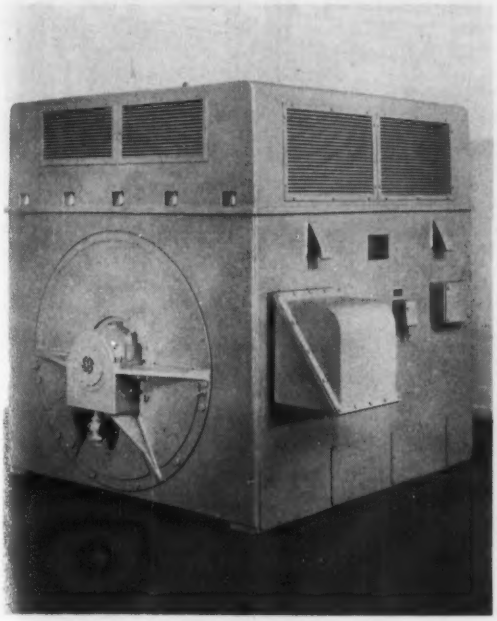
ONE CUTOUT, the Hubbard EHD Faultmaster, will fill the requirements of Standard, Heavy, and Extra Heavy Duty ratings. Buy ONE! Stock ONE! Inventory ONE! Plan for ONLY ONE!

Providing three capacities with one size means lower cost handling, warehousing, engineering and installation—and with the Hubbard EHD, you still get full range protection from minor overloads through the maximum EHD rating. All this—plus the increased safety of Single-Vent, Small-Bore operation. **Why buy three when one will do?**

HUBBARD

AND COMPANY • 200 SOUTH MICHIGAN AVENUE • CHICAGO 4, ILLINOIS

(For further information refer to Reader Service on page 106)



Boiler Feed Pump Motors . . .

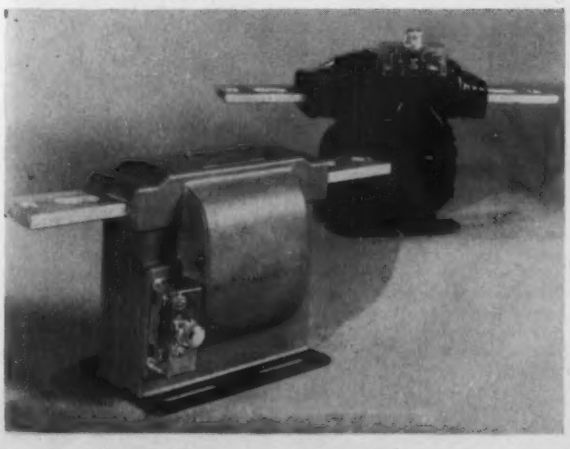
. . . can be disassembled for inspection in five minutes by one man. Design is available in dripproof or weather protected enclosures in ratings from 800 to 7,000 hp. Air flow system is redesigned to improve ventilation and reduce noise level. All vent openings are in top section. With light weight split end shield, one man can prepare unit for inspection or rotor removal with a wrench.

General Electric Co, Schenectady 5, N. Y.

Hot-Stick Tester . . .

. . . can be carried and operated by one man. All types and sizes of hot sticks can be tested. Unit measures true leakage, independent of stray capacitance currents, and operates at ambients up to 105F. No warmup is required. Tester is simple to operate, is not dangerous to user, and will not damage a hot stick that has absorbed excessive moisture. It operates from 110 v ac and can be plugged into standard outlets or used on the job by running extension to the secondary. Calibration standard, instructions, and case are included.

A. B. Chance Co, Centralia, Mo.

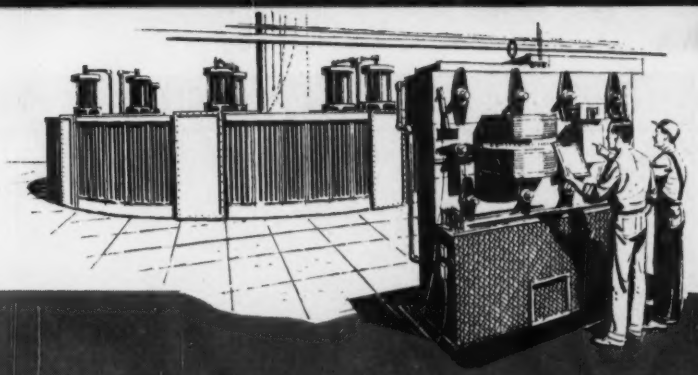


Molded Indoor CT . . .

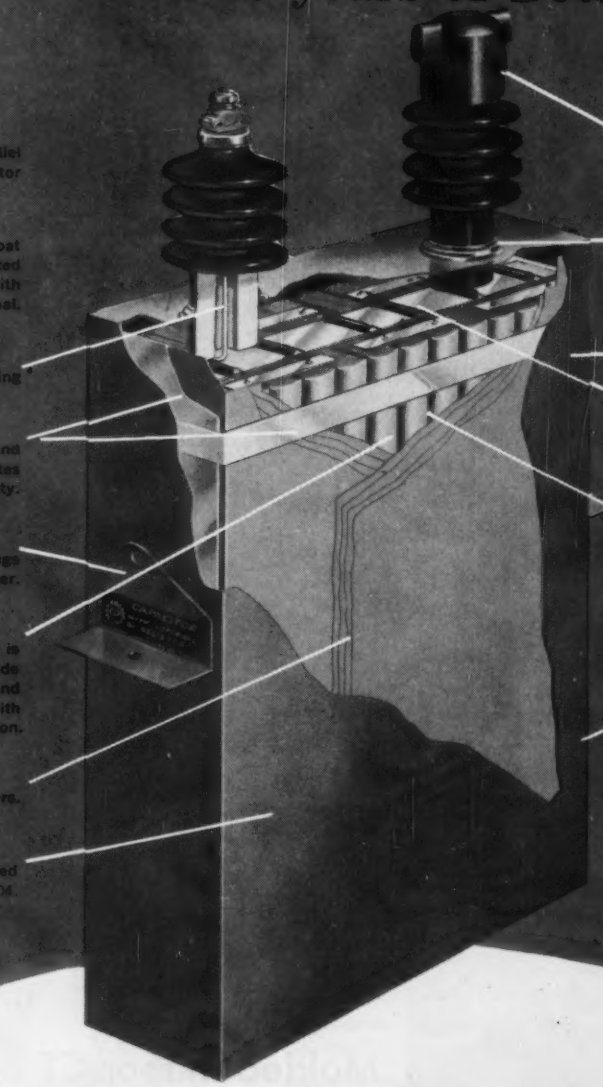
. . . in ratings of 10 through 1,200 amp is available for utility and industrial use in switchboard and switchgear applications. Replacing tape-insulated transformers of the 2,500-v class, type ETC-2.5 has increased mechanical and thermal ratings and can be used under oil. With increased continuous current rating, it will carry 1.5 times rated current without overheating.

Westinghouse Electric Corp, P. O. Box 2099, Pittsburgh 30, Pa.

(*More New Equipment on page* 103)



Based on 10 years of Betatron experience



Convenient 2-piece parallel cable connector

Heavy duty multi-petticoat wet-process, glazed porcelain bushing with integrated solder seal.

Dykanol-filled bushing

Pressure equalizing band and rigid individual plates assure uniform capacity.

Side dual lifting lugs avoid flashover danger.

High impulse level is the result of wide margins between paper and foil, coordinated with major insulation.

Multi-laminated case liners.

Stainless steel used is 18-8 type 304.

One piece moulded insulating terminal caps optional

New type, one piece solder seal design assures permanent hermetic seal.

More durable case

Multiple resistor individually wired for maximum security.

Lowest volts per mil; lower operating temperature and power-factor are the result of C-D's conservative, field-proved engineering principles.

Only C-D capacitors are quality control-tested at full voltage for a period sufficient to reach terminal stability.

Here's why C-D Capacitors consistently exceed all field performance requirements:

• Lowest dielectric unit stress and highest major insulation level. • Dykanol-filled bushings increase accepted flashover safety-factor, insure high level of impulse withstand. • Removable solderless connectors. • Many sections in series-parallel connection. Extremely low voltage gradient per section; less heating; no corona; longer life; lower power-factor. • Discharge resistor connected to each series section, instead of terminal to terminal. Provides effective discharge for each series group and balanced voltage distribution. • Side mounted lifting lugs — stronger and avoid risk of flashover. • Energization tested, 100 percent, to assure uniform distribution of low dielectric losses.

CORNELL-DUBILIER CAPACITORS

"DYKANOL"

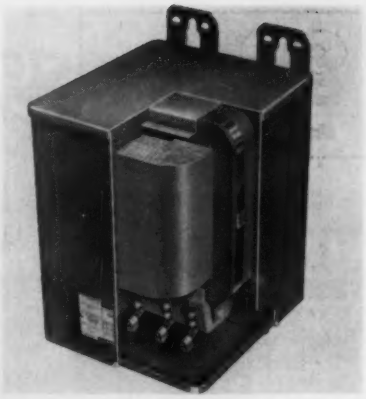
C-D
50 Kvar
CAPACITOR

CORNELL-DUBILIER'S 50 Kvar power capacitors provide the same matchless degree of reliability that customers have enjoyed from C-D's entire power capacitor line for so many years. A special 45 Kvar Betatron type of capacitor in continuous production from 1947 to date has established the unquestionable superiority of C-D's field proved conservative engineering principles. These result in capacitors with the lowest volts per mil (333) and power losses much lower than the NEMA limit of 3½ watts per Kvar. That's why you get more power capacitor value with C-D's.

See for yourself the built-in extras you get in C-D 50 Kvar units. These are your guarantees of performance beyond the usual one-year period. Insure low-maintenance service from your next power-factor installation by talking it over first with a C-D engineer. Just write to Cornell Dubilier Electric Corporation, South Plainfield, New Jersey.

CORNELL-DUBILIER
power-factor capacitors

SOUTH PLAINFIELD, N. J., NEW BEDFORD, WORCESTER & CAMBRIDGE, MASS., PROVIDENCE & PEACE VALLEY, R. I., INDIANAPOLIS, IND., DAYTON, KOKOMO & VARICK, IND., FUQUAY SPRINGS, N. C., VENICE, CALIF. & SEAL BEACH, CALIF., RADIANT ELECTRIC CORP., CLEVELAND, OHIO, CORNELL-DUBILIER ELECTRIC INTERNATIONAL, S. A.



Transformer Line . . .

. . . has voltage ratings extended to the 5-kv class. The dry-type, general purpose transformers (Type EP and EPT) have the higher voltages available on single-phase units, 10 kva and below, and 3-phase units, 15 kva and below. All units have brackets for wall mounting and may be installed either indoors or outdoors.

Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

Air-Powered Pruners . . .

. . . cut green branches up to 2 in. diameter. They are available in a 6-ft insulated model, rated for use on lines up to 69 kv, and a 4½-ft uninsulated model. Jaw blades are alloy steel; bodies are aluminum. Handle of the insulated model is fiberglass. Power is furnished by standard cylinders of dry nitrogen or compressors.

A. B. Chance Co, Centralia, Mo.

(*More New Equipment on page* 104)

C&D AutoCal*
Unitized Power-Pack

Popular mounting arrangement shows how *AutoReg*® Silicon Charger mounts inside switchgear cubicle door with controls projecting through. No manual switching or other adjustment required. PlastiCal® batteries need watering only once a year.

New C&D *AutoCal** *unitized* Power-Pack is specially designed for dependable switchgear tripping and control

Simple *AutoReg*® voltage regulated, current limiting Silicon Charger, paired with long-life PlastiCal® battery, assures high-capacity d-c power in compact package that is virtually *maintenance-free.*

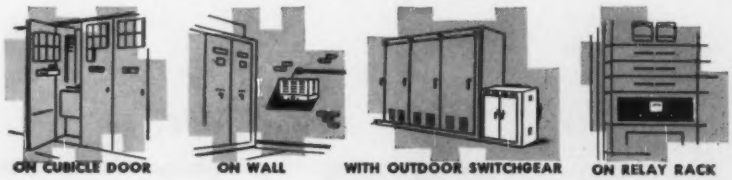
Now, utilities and industrial plants can guarantee an even greater margin of reliability and protection for switchgear and control equipment. The amazing new C&D *AutoCal unitized* Power-Pack always assures full power for tripping and control.

Here, for the first time, is a dependable, high-capacity power package *specially designed for tripping and control.* Virtually maintenance-free . . . with no manual switching or adjustment required . . . *AutoCal* provides many times the life of ordinary battery and charger combinations which may be *adapted* to this critical service.

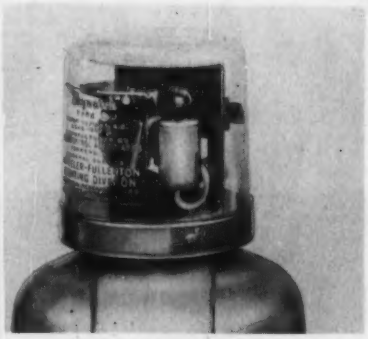
AutoCal pairs the simple, compact *AutoReg* Silicon Charger with powerful PlastiCal lead-calcium-grid control batteries. A sudden demand for tripping power merely discharges the battery over a short period. While the breaker is tripped, PlastiCal supplies any necessary constant load current as might be required for the operation of pilot lights, holding coils, and similar requirements. Once the circuit is reclosed, *AutoReg* puts energy back into the battery at a high rate until it levels off at full charge.

Here's self-protected charging . . . no charger adjustment or maintenance . . . and 25-year-life PlastiCals only require watering once a year!

For full details—write for Bulletin AR-102 today!

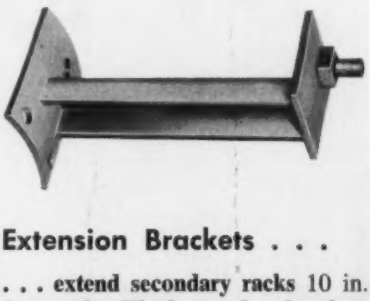


C&D
Since 1906
C & D BATTERIES, INC.
of Conshohocken, Pa.... Attica, Ind.
Sales and Service Offices in Principal Cities from Coast to Coast
Manufacturers of *Styrr-Clad*® Industrial Batteries • PLASTICELL* and PLASTICAL® Batteries for Communications, Control and Auxiliary Power • Producers of *Autoreg*® Silicon Chargers
**Trademark: AutoReg® Silicon Charger and PlastiCal® Battery.*



Lighting Control . . .

. . . is adaptable to any street light now in operation. Known as "Skywatch," the device responds to sky luminosity and cannot be accidently actuated by automobiles or neon lights. The operating level is 1 to 1.5 foot candles at the turn-on point and 2 to 3 foot candles at the turn-off point.
Wheeler-Fullerton Div, Franklin Research Corp, 275 Congress St, Boston, Mass.



Extension Brackets . . .

. . . extend secondary racks 10 in. from poles. The heavy-duty brackets afford additional climbing space and clearance between secondary conductors and other equipment. Features include high strength, rigidity and economy of installation.
Line Material Industries, McGraw-Edison Co, Milwaukee 1, Wis.

Weed Killer . . .

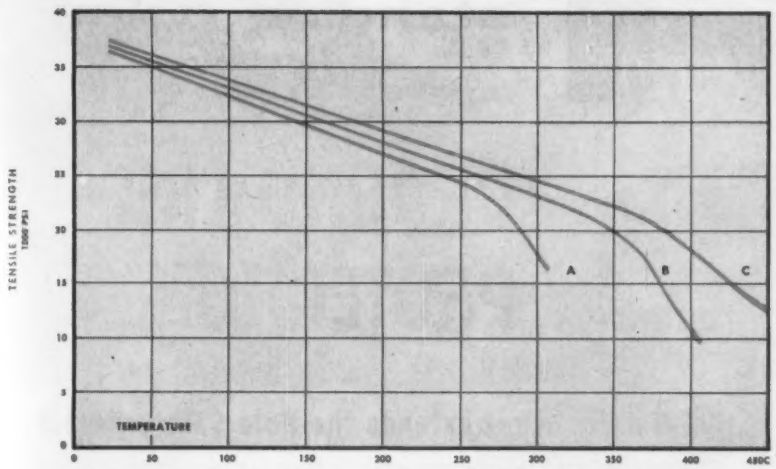
. . . for cooling water ponds is now available. The product, known as Kuron, is effective in controlling aquatic weeds such as water milfoil, fanwort, bladderwort and waterweed. Spray concentrations involve no hazard to workmen and are not corrosive to machinery. It is effec-

(*Continued on page* 108)

ANACONDA® COPPER PRODUCTS

FOR THE ELECTRICAL INDUSTRY

THE AMERICAN BRASS COMPANY • WATERBURY 20, CONN



A. Silver content normal. **B.** Silver 8.7 ounces per ton. **C.** Silver 28 ounces per ton.

Silver-bearing coppers give a margin of safety in operating conductors at elevated temperatures

In heavily loaded motors and generators, the windings, collector rings, and commutators must retain their strength at the higher operating temperatures that have become the rule. And there are now many other places where copper conductors must operate at temperatures well above those heretofore considered normal.

Electrolytic copper—with a very small amount of silver added—is superior to any other commercial conductor metal for use at these higher temperatures. Anaconda silver-bearing copper retains the structural design strength of the conductor at the higher operating temperatures. Annealing temperature is raised and softening delayed. The margin of safety is improved. How much gain you can count on is indicated by the chart above.

The curves are the result of tests made by the Metallurgical Research Laboratory of The American Brass Company.

There are three standard Anaconda alloys: Silver Bearing Copper-111, silver 8 troy ounces per ton, average conductivity, annealed, 101%; Silver Bearing Copper-112, silver 10-15 troy ounces per ton, average conductivity, annealed, 100.5%; Silver Bearing Copper-113, silver 25-30 troy ounces per ton, average conductivity, annealed, 100%.

More detailed information concerning the influence of silver on the tensile properties of high-conductivity copper at elevated temperatures is given in Publication C-25, "Anaconda Copper for Electrical Conductors." Included are curves for yield strength at 0.2% offset and 0.5% extension—indices of the limits of elastic behavior—of interest to design engineers.

DO YOU KNOW THESE ELECTRICAL COPPERS?

DLP COPPER-104 (Cu 99.9+, P 0.01) average conductivity, annealed, 97%. High-conductivity type of phosphorus deoxidized copper excellent for brazing, soldering—is being used increasingly by electronics manufacturers—also in such places as transformer bushings.

CHROMIUM COPPER-999 (Cu 99.05, Cr 0.85, Si 0.10) average conductivity, annealed, before heat treatment, 40%; after precipitation hardening, 80%. This unique alloy when precipitation-hardened has very good mechanical properties well above 200 C. This leads to its use, for example, as tips and wheels in resistance welding equipment. Is also regularly used for switch contacts and similar applications at around room temperature.

BELOW: Railway motor commutator segments, having precise taper and contour, made of Anaconda Silver Bearing Copper-113.

Electrical conduit and raceways of tough, nonmagnetic Everdur guard circuits from corrosion, vibration

Where power, control, or signal circuits must be buried, hidden, or protected from severe corrosive conditions and vibration, electrical conduit or seamless raceways of Everdur® give enduring protection. Everdur, Anaconda copper-silicon alloy, offers not only unusual resistance to corrosion, but also high strength and resilience to withstand movement, vibration, abrasion, and rough use. In addition it is nonmagnetic, providing electrical advantages. For complete information write for Publication E-12. 8971

RIGHT: 90-degree bends made in 3", 3½", and 4" Everdur raceways.

Readers Service

For additional information on new products, supplies, and services in this issue, the Manufacturers Editor of Electrical World offers his facilities. Check items in which you are interested in list below.

NEW EQUIPMENT

GE ..... Motors ☐
Chance ..... Stick Tester ☐
Westinghouse ..... CT's ☐
Westinghouse .. Dry Transformers ☐
Chance ..... Pruners ☐
Wheeler-Fullerton ..... Control ☐
L-M ..... Brackets ☐
Dow Chemical ..... Weed Killer ☐
Sprague ..... Locator ☐
Applied Science .... Telemetering ☐
Preformed ..... Hardware ☐
Malleable Iron ..... Bracket ☐
Technique Associates .. Voltmeter ☐
Franklin ..... Conduit ☐

MANUFACTURERS LITERATURE

Code No. .....

(Requests are made from code numbers on page 115).

OTHER

Manufacturers Editor
Electrical World
330 W. 42nd St.
New York 36, N.Y.

* **Note: Requests must be received within four weeks of publication date, accompanied by complete information, specified. This service cannot be offered to readers in foreign countries or to competitive manufacturers.**

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TITLE _____

DEPT. _____

COMPANY _____

ADDRESS _____

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Specs ..... ☐
Trial ..... ☐
Purchase ..... ☐

MAY 18, 1959

New, low-cost way to give old standing poles

GROUND-LINE PROTECTION

Pol-Nu treatment extends the Pole Safety Factor

Pole Safety Factor can be measured in terms of preservative in the wood in the critical ground-line area. Treated poles, as offered by the wood preserving industry, have maximum initial protection against decay and insect damage. However, there is a natural depletion of the protective chemical at the ground-line and this will eventually cause failure if preservative losses are not replaced.

A planned pole inspection program and ground-line treatment with Chapman Pol-Nu protects your line investment. Pol-Nu is a superior grease-type preservative containing a full 10% PENTA-chlorophenol. With the exclusive Pol-Nu Bandage-Maker it is easily applied to standing poles to restore the reservoir of preservative, adding up to 15 years of pole life. The modest application cost is chargeable to maintenance dollars, not the more expensive capital dollars required for pole replacement. Get complete information now, from Chapman Chemical Company.

Portable Pol-Nu Bandage-Maker produces pole bandages of exact size instantly on the job. Pol-Nu preservative feeds onto paper in a uniform, accurate coating.

Bandage is wrapped around previously cleaned pole, may be applied immediately without waiting for wood to dry. Pol-Nu penetrates wood to give lasting protection.

write for complete information

CHAPMAN®
POL-NU
and Pol-Nu Bandage-Maker

CHAPMAN CHEMICAL COMPANY
Leading manufacturer of wood preservatives
P. O. Box 138-B, Memphis 1, Tenn.

PALO ALTO, CAL. • PORTLAND, ORE. • MINNEAPOLIS • CHARLOTTE, N. C.

There IS a Difference!

Connectors may look alike but it's PERFORMANCE that counts

BLACKBURN CONNECTORS OUT-PERFORM THEM ALL

Because They Are...

BETTER MECHANICALLY

- Made of high strength duronze, a silicon bronze alloy stronger than structural steel.
- Machine cut threads, *CFC treated, provides more thread engagement —reduces friction and increases thread efficiency. *Chemical Friction Control.
- Rigid inspection of each production operation assures uniformly good connectors.

BETTER ELECTRICALLY

- High clamping force—the result of greater thread efficiency breaks down oxide on the conductor improving conductivity.
- Higher initial conductivity, actually greater than an equal length of conductor is maintained permanently.

REUSABLE

- Selection of proper high-strength, corrosion-resistant materials—plus precision workmanship and inspection—means Blackburn connectors may be used over and over.

BLACKBURN *Hi-Strength* **CONNECTORS**

AVAILABLE AT ELECTRICAL WHOLESALERS EVERYWHERE

JASPER BLACKBURN CORP., 1525 Woodson Rd., St. Louis 14, Mo., WYdown 3-9430

Reduces Structural Supports 50%!

When the chips are down, it's the *installed* cost that counts . . . whether it is a self-grounding, maintenance free Husky extra-strength cable support system or an ordinary one. And now, Husky brings you the substantial time, labor and material savings of "Long-Span" Design.

Want proof and details? Write for "Long-Span" Design data or send us your cable support problem (indoor-outdoor) for analysis.

Representation from coast to coast

HUSKY PRODUCTS, INC.

5300 Vine Street Cincinnati 17, Ohio

Weed Killer . . .

(*Continued from poge* 104)

tive in concentrations as low as two parts per million, leaving a substantial margin of safety to fish and to wild animals.
Dow Chemical Co, Midland, Mich.

Interference Locator . . .

. . . finds sources of radio and TV interference quickly. The Sprague Model 500 has a tuning range of 550 kc to 220 mc in six tuning bands. The unit is powered from either a 115/230-v, 50-60-cps external supply, or in field use by a rechargeable wet cell. A battery charger is built into the instrument for overnight recharging. The unit weighs only 28 lb including battery.
Sprague Electric Co, North Adams, Mass.

Telemetering System . . .

. . . transmits over a single teletype, voice or microwave channel; or over a single metallic pair. A single system can transmit and receive up to 30 data points with an accuracy of better than 99%. Milliammeters, voltmeters, round or strip-chart recorders, etc., can be operated by the receiver.
Applied Science Corp of Princeton, Box 44, Princeton, N. J.

Pole Hardware Line . . .

. . . is now offered in "Alumoweld". The line of splices, armor rods, and "Guy-Grip" dead-ends is available in sizes to accommodate all 3 and 7-wire conductors and guy strand sizes offered in "Alumoweld". The line is particularly

(*Continued on page* 110)

The "Crumble Test" proves superior heat resistance of Westinghouse Insuldur-system insulation . . . J. C. Gardner, Westinghouse network transformer representative at the Sharon, Pa., plant, demonstrates how overload and summer heat can "kill" insulation in transformers without the Insuldur system . . . while Insuldur system "stays alive."

Higher ambients, same overloads...but no heat damage

WITH WESTINGHOUSE SPACE-MISER NETWORK TRANSFORMERS

Now . . . Insuldur system guards insulation life in Westinghouse Space-Miser network transformers

Heat is the major threat to transformer insulation life —whether from emergency overload conditions or high summer ambients.

The new Insuldur* insulation system now available in Westinghouse oil-immersed Space-Miser network transformers reduces the heat threat from both sources.

Now, higher emergency overloads can be carried without fear of shortening insulation life . . . because Westinghouse network transformers with the Insuldur system operate *safely* at temperatures up to ten degrees higher than previous safe temperature limits.

Summer heat wave problems are reduced, because load-carrying ability is assured for ambients up to ten degrees higher with the Insuldur system.

The Insuldur insulation system is a Westinghouse exclusive—no other network transformer has this positive insulation-life protection.

Westinghouse oil-immersed network transformers with the Insuldur insulation system retain dollar-saving flexibility . . . easy future change to Inerteen® should the need arise.

Ask your Westinghouse representative about the Insuldur insulation system . . . a "Bonus Value" from Westinghouse Plowback of Earnings into research.

*Trade-Mark

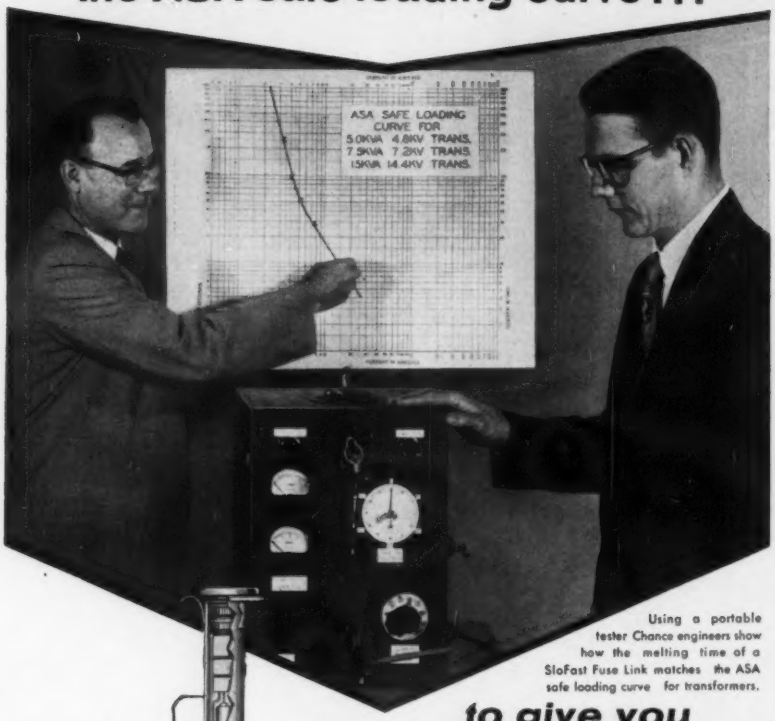
J-70898

YOU CAN BE **SURE**...IF IT'S

Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

CHANCE SloFast Fuse Links follow the ASA safe loading curve . . .



Using a portable tester Chance engineers show how the melting time of a SloFast Fuse Link matches the ASA safe loading curve for transformers.

Two current responsive elements: A slow element that operates on secondary faults and heavy overloads beyond the transformer capacity to protect the transformer; a fast element that operates to isolate the transformer and protect the system if internal failure or bushing flashover occurs.

Linemen can easily remove Chance fuse links from containers without removing gloves. A slight firm twist separates the single container from the 5 unit container. The end of each unit container is perforated for quick removal of the link. Type and rating are clearly marked on both ends of each unit container.

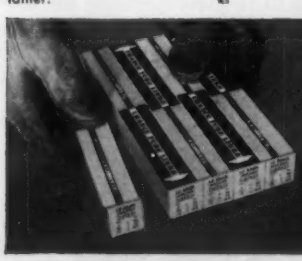
to give you Full Overload Capacity Transformer Protection without unnecessary outages

Chance SloFast (dual element) fuse links improve customer service continuity by providing for upward load swings that are within the safe limits of the transformer, while at the same time giving definite protection from damage or "burnout." A slow and a fast fuse element teamed up in a single link allow full use of transformer overload capacity, protect against secondary short circuits and overloads beyond safe values, and isolate the transformer from the system in the event of internal failure or bushing flashover. A plus advantage of Chance SloFast links is that repeated outages indicate the transformer is overloaded beyond safe limits and suggest the use of a larger transformer.

SloFast fuse links are available in both button-head and open link styles in a range of sizes from 0.2 to 10.4 amps . . . a link tailored for every rating of pole-mounted distribution transformer.

Write for Bulletin "Fuse Links and How to Use Them." It gives performance curves and application tables for all distribution voltages.

CF59-10



A. B. CHANCE CO.

CENTRALIA, MISSOURI

Pole Hardware Line

(*Continued from page* 108)

suited to conditions requiring high conductivity, extra strength and corrosion resistance.

Preformed Line Products Co, 5349 St. Clair Ave, Cleveland 3, Ohio

Pole Top Bracket . . .

. . . and angle transition piece improve convenience and economy of line post insulator mounting. The P532 Pole Top Bracket has spaced teeth cast into the pole contacting surface to provide efficient transfer of both vertical and transverse loads to the pole. The P533 Transition Piece is designed for use separately on cross arms or with P532 on line angle structures.

Malleable Iron Fittings Co, Branford, Conn.

Voltmeter . . .

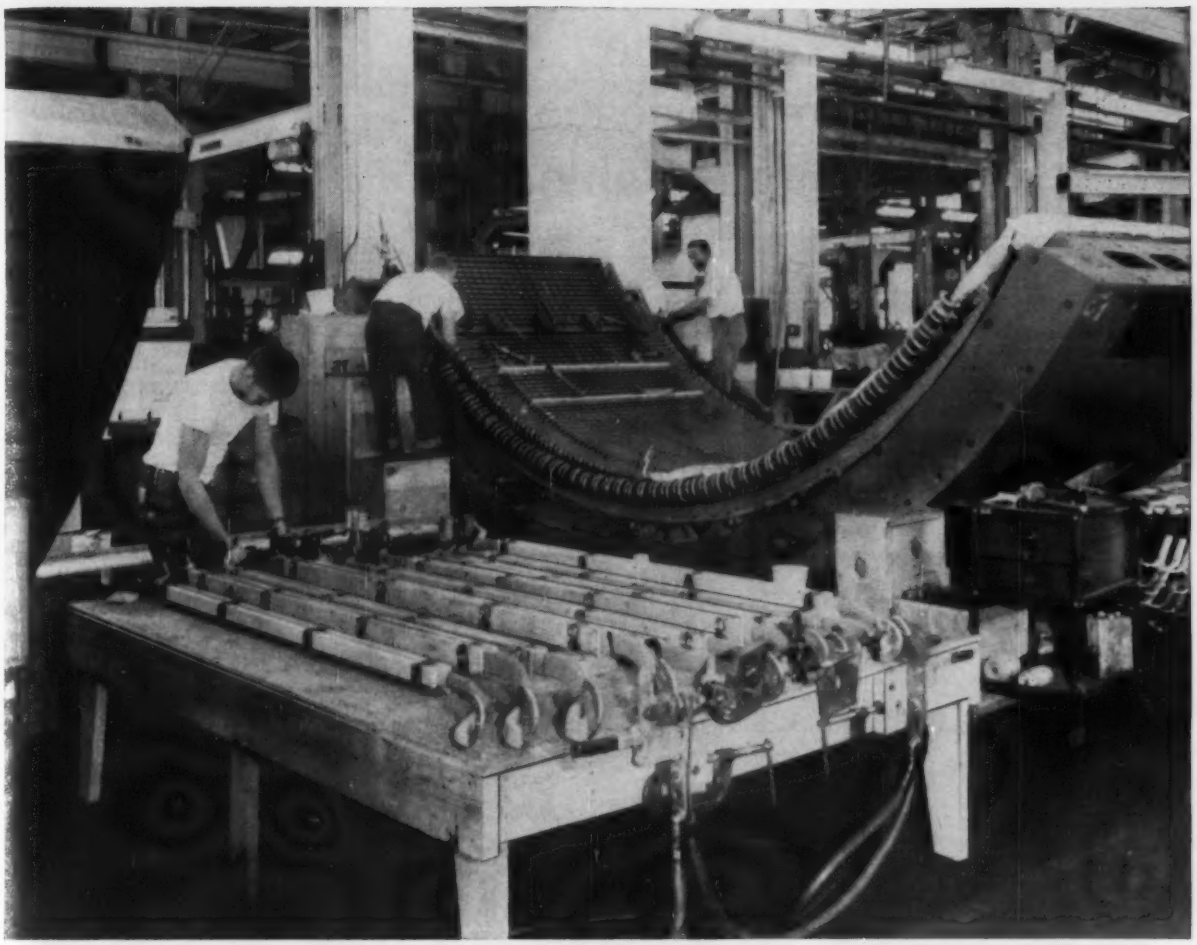
. . . of contact-making type accurately controls or regulates ac voltages. The meters have a moving disk (induction type) measuring element of high sensitivity which will detect voltage variations as small as ½ v. A set of adjustable contacts on the movement is used to actuate a built-in power relay which will handle loads up to 20 amp directly.

Technique Associates, Box 91, Indianapolis 6, Ind.

Plastic Conduit . . .

. . . can be assembled and laid by one person in sizes up to 30 ft in length. Known as DUR-X, the conduit weighs only one-eighth as much as steel pipe. Solvent-welded connections are made by applying a thin layer of cement with a brush. The conduit is made in 2, 3 and 4-in. sizes.

Franklin Plastics, Inc, Franklin, Pa.



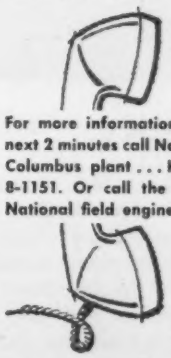
King-size rebuilding job by National

...*The* Specialists in electric coils... repair service

Severely damaged by fire, this 30,000 kva generator required complete rebuilding. Since the fire had warped the stator, it was shipped to National Electric Coil's Columbus plant, where the first job was to remove the laminations and straighten the frame. Damaged laminations were replaced with new ones and the core restacked. Coils, manufactured by National, are shown in the illustration being wound into a section of the stator which was of such size that it was built in thirds to make rail shipment possible.

After thorough testing, the stator was shipped back to the customer, assembled on the site, and the winding lap between each of the sections completed.

Whenever you need service on rotating electric machinery—whether large or small, whether you need a few coils or a complete rebuilding job—contact National Electric Coil. Our service is fast, thorough and guarantees satisfaction.



For more information in the next 2 minutes call National's Columbus plant... HUdson 8-1151. Or call the nearest National field engineer.

National Electric Coil

McGRAW EDISON

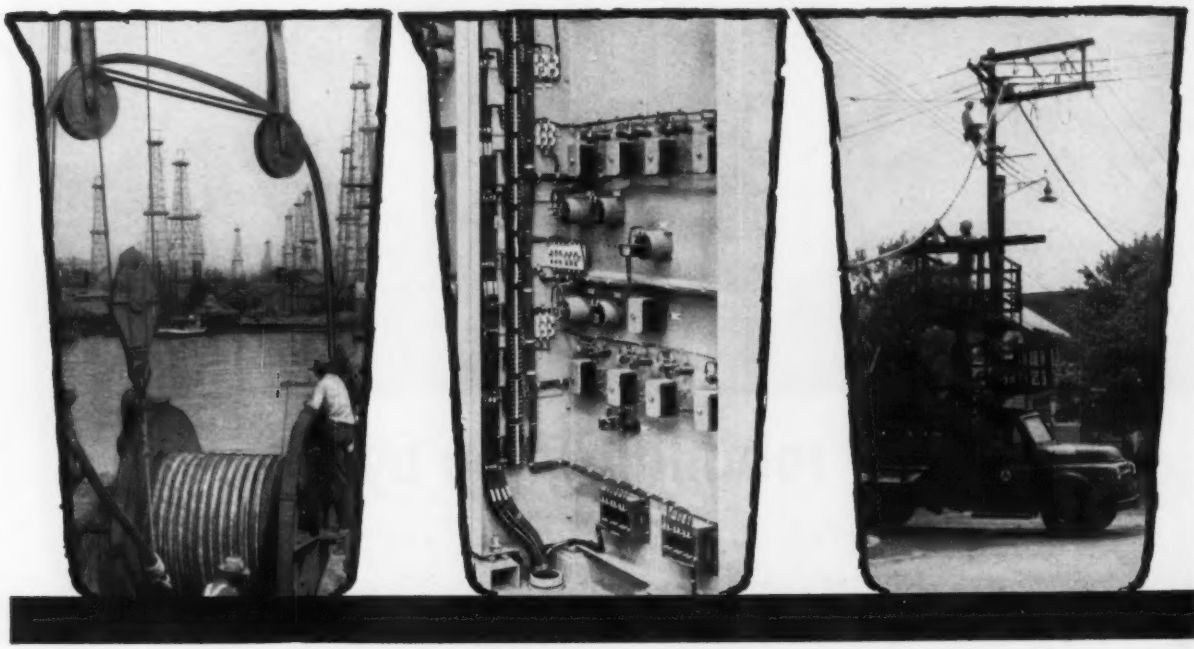
DIVISION OF McGRAW-EDISON COMPANY

COLUMBUS 16, OHIO

ELECTRICAL ENGINEERS • MANUFACTURERS OF ELECTRICAL COILS, INSULATION, LIFTING MAGNETS • REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

from the
laboratories of
General Cable...

PREMIUM QUALITY INSULATION COMPOUNDS



AQUASEAL

low SIC, superior, rubber compound that is heat and water resistant, used on single and multiple-conductor cables at ratings up to and including 2KV a-c or d-c. Recommended for dry, alternately wet and dry, and continuously wet locations, subject to a-c or d-c potentials at either polarity, and at a maximum conductor temperature of 75C.

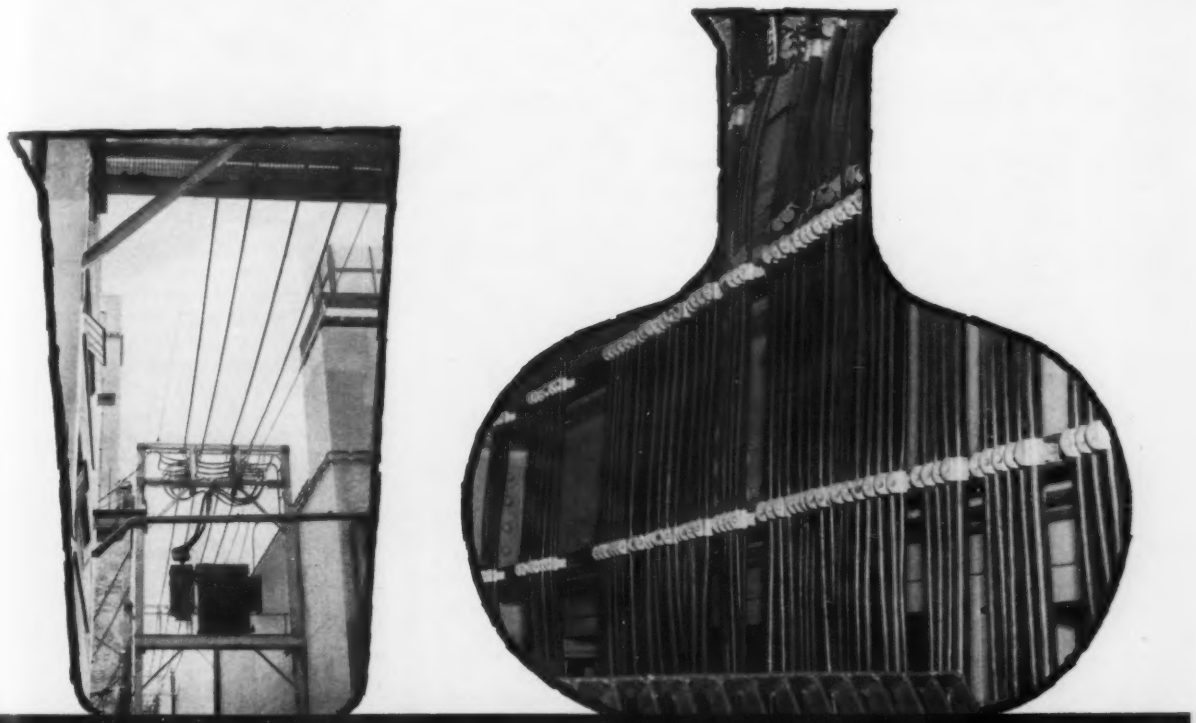
GENCORONE

high-voltage, ozone-resistant insulation of the oil base type, with exceptional physical and electrical stability. Resists the effects of moisture, sunlight, weather and earth solutions. Permits liberal current ratings consistent with maximum continuous operating temperatures of 75C for 8KV service or lower and 70C for higher voltages.

BUTARONE

high-voltage, butyl-base compound with exceptional resistance to ozone, low water absorption, and excellent resistance to heat. Suitable for both low and high-voltage applications, it has excellent electrical stability and resistance to aging. Operates at 90C up to 5KV and at 85C at higher voltages.

In the modern General Cable laboratories, some of America's foremost rubber chemists create, test and evaluate new insulation compounds in a continuous program of research and development. Materials for standard service conditions and special constructions to satisfy unusual requirements have all proven their worth in superior performance in power and control cables over many years. A few of the basic compounds from General Cable's long list are briefly described on these pages.



THERMAX-W

and many other compounds in the rubber group are available for low and moderate voltage power cable service in wet locations, where high temperatures are encountered or where high current carrying capacity is required.

GENCASEAL (PVC)

in the thermoplastic group, as well as high-molecular-weight polyethylene, which is another outstanding General Cable thermoplastic insulation.

Offices and Distributing Centers Coast-to-Coast

GENERAL CABLE CORPORATION, 420 Lexington Avenue, New York 17, N.Y.

for quality and service specify... GENERAL CABLE

Kellogg Microwave Controls Utility Operations

"Operation of these microwave channels has proven to be far superior to even the best constructed wire lines."

This is the opinion of a leading western utility company describing the overall extensive microwave system of which a 400-mile Kellogg PTM microwave network is part. With eight channels on some circuits and as many as 23 on others, the Kellogg portion includes 17 stations. There are 13 terminals, two junctions stations and two drop station repeaters.

Modern, *reliable* Kellogg Microwave is an economical, sure and convenient way to coordinate and direct such vast and complex systems as a utilities operation. This western system, for example, carries normal telephone trunks and individual telephone lines, as well as performing vital telemetering and automatic load and frequency control functions.

Today, with dual path systems, Kellogg microwave users have even more reliability at their command. With dual path, all switchover equipments or circuits are eliminated. A failure of one of the units will not interrupt traffic, hence there is no traffic time loss as a result of switching to standby.

Reliability is increased since both operating units are continuously monitored. Space or frequency diversity equipments may be added to the dual path system with a minimum of additional components.

The Kellogg Model 10C-2 PTM Microwave System now features up to 45 channel multiplexing equipments. Channels are readily arranged to suit the needs of specific installations whether for telemetering, remote control, data and voice transmission. Our engineering staff is always at your service ready to discuss your communications problems.

KELLOGG Communications Division of IT&T
CHICAGO, ILLINOIS

Kellogg Switchboard and Supply Company, 6650 South Cicero Avenue, Chicago 38, Illinois. Communications Division of International Telephone and Telegraph Corporation

Regional Offices and Warehouses:
CALIFORNIA: 23 Broderick Road, Burlingame, Calif., OXford 7-5780.
GEORGIA: 1594 Southland Circle, N. W., Atlanta 18, Ga., SYcamore 4-2441.
ILLINOIS: 4600 So. Tripp Ave., Chicago 32, Illinois, CLiffside 4-4300.
KANSAS: 7th & Sunshine Road, Kansas City 15, Kansas, MAyfair 1-4418.
MINNESOTA: 6100 Excelsior Blvd., Minneapolis 16, Minn., West 9-6715.
NEW YORK: 327 North West Street, Syracuse, N. Y., HArrison 2-9251.
OHIO: 1555 West Fourth Street, Mansfield, Ohio, LAfayette 4-6511.
TEXAS: 1515 Turtle Creek Blvd., Dallas 7, Texas, RIverside 7-5191.
EXPORT: 157 Prospect Street, Passaic, N. J., PRescott 3-5100.

Why Kellogg PTM is Setting New Performance Standards:

Microwave has made huge strides since first pioneered by International Telephone and Telegraph Corporation in 1931. Here are 10 reasons why Kellogg's Pulse-Time Modulation Microwave, perfected by ITT research, is inherently superior.

1 Easy maintenance, particularly of the RF equipment; visual test and check methods may be used.

2 Tubes may be changed at random *without* realigning the Intermediate Frequency Amplifier.

3 Where propagation is a problem due to multi-path cancellation, it is simple to install space diversity reception equipment.

4 Drop channels may be installed at random, without need to demodulate entire groups to audio.

5 Economical system design: drop and insert channels may extend only throughout those parts of the system where required, and not the entire length.

6 Maximum transmitter tube life; tube life averages approximately 15,000 hours for 2C39s.

7 All PTM channels are interchangeable, only one spare is required.

8 High signal-to-noise ratio: the inherent noise of each channel is "clipped" out. Each terminal and each repeater station transmits a fresh signal.

9 Less tower rigidity required for accurate signal transmission at 2000 mc.

10 Plug-in channel units feature printed circuitry replacing tubes with crystal diodes; demodulators semi-passive, one tube per channel; modulators passive, no tubes. Results in 4:1 reduction in the number of tubes and 5:1 reduction in power consumption.

Investigate these and other advantages of a Kellogg PTM Microwave system. Write for complete details.

Manufacturers Literature

To request literature, use code numbers indicated for each item when filling in Reader Service form on page 101.

APPLICATION PROCEDURE ON SPLICES . . . for messenger strands, guy strands, ground wires and open line wires. Photos illustrate each process, reference tables specify splice sizes and color codings for corresponding sizes and types of strands. Pocket-sized 8-page booklet No. 85-300. Preformed Line Products Co, 5349 St. Clair Ave, Cleveland 3, Ohio.

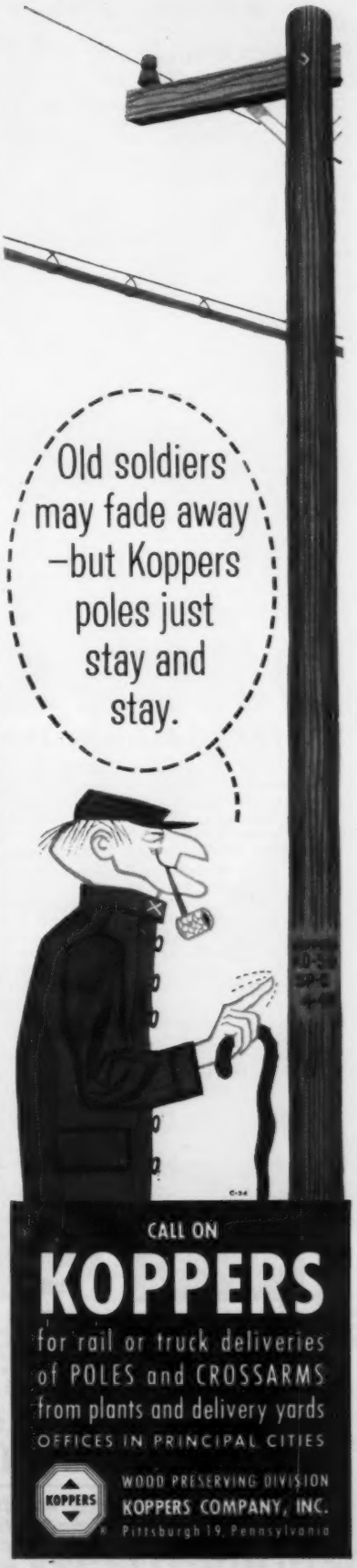
ALUMINUM-COVERED STEEL WIRE & STRAND . . . for reinforced aluminum construction on overhead lines, complete with illustrations and engineering data, provides complete working knowledge of new "Alumoweld" material. Controlled atomic weld described. Twelve-page catalog, E.D. 3000. Copperweld Steel Co, Frick Bldg, Pittsburgh 19, Pa.

SWITCHBOARD INSTRUMENTS . . . mechanism types, accuracy, scale length, rating, terminals, dimensions, weights, cases and list prices, for 13 types of instruments are described fully and illustrated. Data on accessories, ordering procedure, service, shipping and repairs included. Catalog 4220, 24 pages. Roller-Smith, Inc, 50 Ave L, Newark 1, N. J.

NUCLEAR POWER ACCELERATION . . . G.E.'s Atomic Acceleration Program for utilities is described. The technical development part of the plan, "Operation Sunrise" is included in this 22-page brochure with illustrations. General Electric Co, 1 River Rd, Schenectady 5, N. Y.

ALUMINUM CONDUCTORS . . . current-temperature characteristics is first of a series of technical reference manuals to be issued. It comprises section six of Alcoa's program on aluminum overhead conductor engineering data. Graphs and information on ACSR and stranded aluminum conductor, formulas to facilitate calculation of characteristics for other sizes are given. Aluminum Co of America, 1501 Alcoa Bldg, Pittsburgh 19, Pa.

CIRCUIT BREAKER SERVICE ENTRANCES . . . and fuse equipment with complete description of the Uni-Pak packaging line covered in 32-page catalog—60, 100, and 200 amp, series or parallel connected. Speedfax catalog with separate price index No. 4-59. Walker Electrical Co, Inc, P. O. Box 2308, Station D, Atlanta 9, Ga.


Old soldiers may fade away –but Koppers poles just stay and stay.
CALL ON
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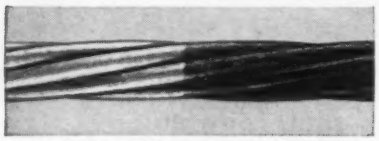
WOOD PRESERVING DIVISION
KOPPERS COMPANY, INC.
Pittsburgh 19, Pennsylvania

ADVERTISEMENT

Rugged 5-year field test proves superiority of ACCO ALUMINIZED Strand

Convincing proof of ACCO ALUMINIZED Steel Strand's matchless ability to "stand up" in highly corrosive, heavy industrial areas is furnished by a 5-year field test recently completed by a leading Eastern power company.

A section of ACCO ALUMINIZED High Strength Guy Strand, installed in 1953, was removed and subjected to thorough examination, including various laboratory tests and measurements. The wire surface was covered with a formation of sulfide, oxide and soot; but, after scrubbing with soap and water, the aluminum coating was shown to remain *bright, smooth and unattacked* by the highly sulfurous atmosphere (*see photo*).



Loss of weight of the aluminum coating during the 5-year exposure proved negligible. Tests showed that the physical properties of the wire and coating continuity were exceptionally good. All in all, the determinations indicated that the ACCO ALUMINIZED Strand would give *many additional years of outstandingly satisfactory service.*

"Far Greater Life . . ."

In another test, the ability of PAGE ACCO ALUMINIZED Strand to withstand exposure to extreme salt atmospheres is proved, as revealed by the following excerpts from a letter written by an official of a public water authority:

"We have obtained excellent results with ACCO ALUMINIZED guy wire. We ran several tests in the Metropolitan Area where there was exposure to the salt atmosphere from the sea. We used galvanized strand and your (ACCO ALUMINIZED) strand on the same poles.

"Results indicated *far greater life* for ALUMINIZED. After 8 months, the galvanized was rusted, whereas the ALUMINIZED showed no signs of oxidation or deterioration. As a result of our tests, our original purchase of ACCO ALUMINIZED guy wire was followed by another, and larger, order. This wire is used where we must have a product with high resistance to corrosion."

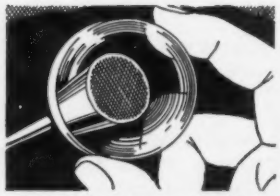
PAGE STRAND

of ACCO ALUMINIZED STEEL

In 1954, PAGE announced to the industry the successful development of a process for combining two time-tested but dissimilar metals, on a production basis, into a revolutionary new wire for increased resistance to corrosion: *Steel* for strength coated with *Aluminum* for corrosion-resistance.

Early laboratory results on accelerated Salt Spray testing which were favorable to ACCO ALUMINIZED over galvanized by a wide margin, are now being confirmed by results of field tests on installations of ACCO ALUMINIZED Strand exposed to the elements over a period of 3 to 5 years. The remarkable performance of the product in both industrial and marine atmospheres is now assured.

Now PAGE offers ACCO ALUMINIZED Steel Strand for guy wire, ground wire and messenger wire. Available in a wide range of sizes, in 3-, 7- and 19-wire construction. It can be used with Preformed Guy-Grip dead-ends made of ACCO ALUMINIZED Wire, or with galvanized pole hardware.

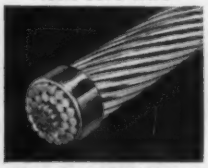


ALL STANDARD GRADES

PAGE ACCO ALUMINIZED Steel Strand is available in Common, Siemans-Martin, High Strength, Extra High Strength, and Utility grades with physical properties meeting ASTM Spec. A-122-54-T and A-363-55-T.

Other PAGE Wires of ACCO ALUMINIZED Steel

ACSR Core Wire



PAGE ACCO ALUMINIZED ACSR Core Wire is now available from leading manufacturers of aluminum conductor cable.

Chain Link Fence

PAGE Chain Link Fence of ACCO ALUMINIZED Steel Wire fabric, provides longer-lasting protection at a long-range saving.

Also . . . ACCO ALUMINIZED Telephone and Telegraph Wire, Barbed Wire —and other products

SEND TODAY for Booklet DH537-A. Write our Monessen, Pennsylvania office

ACCO for Better Values

Page Steel and Wire Division
AMERICAN CHAIN & CABLE

Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Bridgeport, Conn.

ACCO

TRADE MARK

TVA Builds 500-Mw Unit

(*Continued from page* 72)

All fly ash, bottom ash, and pyrites are pumped by the bottom-ash ejectors to the ash disposal area. Use of the common disposal lines minimizes the calcium carbonate deposits in the lines, the bottom ash acting as scouring agent.

Water will be treated in sodium zeolite units. If operating experience shows that a reduction in CO_2 would be desirable, a hydrogen zeolite unit will operate in parallel with existing units.

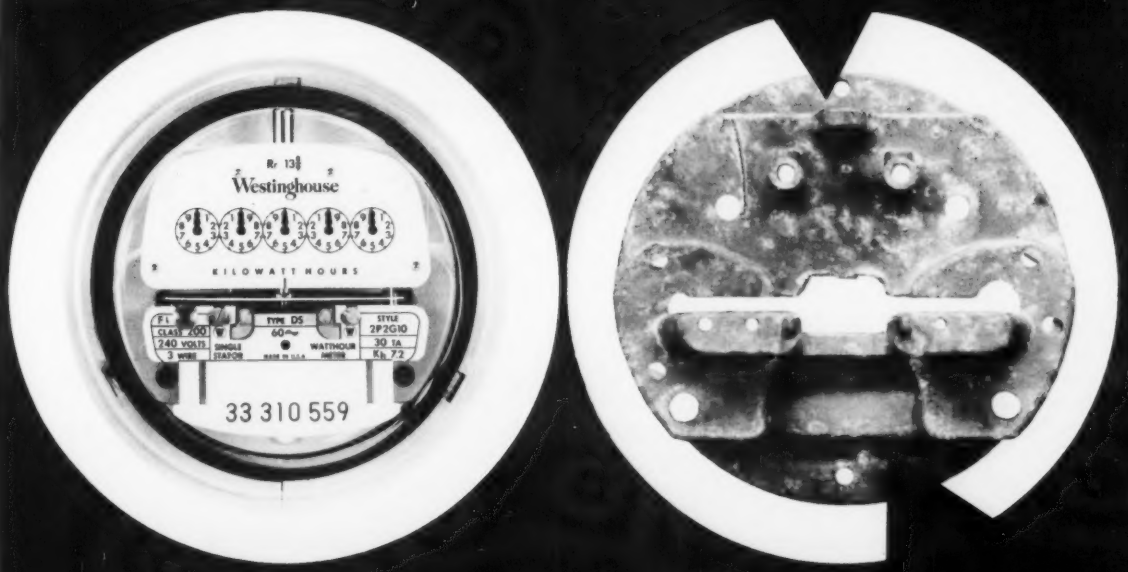
The secondary or internal water conditioning will be "zero treatment," *ie,* no treating chemicals will be used which would add solids to the water. Hydrazine will be used as the oxygen scavenger and ammonia for pH control. Sodium phosphate pumps will be provided, but will be used only when a condenser leak causes dissolved solids to enter the system.

Powerhouse Enclosed

All alloy steel pipe will be silicon-killed and made by the electric furnace or open-hearth process. Main steam lines will be designed for 2,600 psig, 1,053F, of ASTM A369-55T, grade FP22, forged and bored pipe; the two principal sizes required are 21¾-in. OD with a 3⅞-in. wall and 15½-in. OD with a 2¾-in. wall. High-temperature reheat lines will be designed for 490 psig, 1,003F, of ASTM A155-56T, grade 1¼ Cr, class 1, rolled and welded plate pipe; the two principal sizes required are 24-in. OD and 18-in. OD, schedule 60. The 24 and 16-in. OD low-temperature reheat lines will be schedule 40, ASTM A106-55T, grade B, seamless carbon steel pipe.

The powerhouse is entirely enclosed, having a building volume ratio of 17.5 cu ft per kw, including boiler room, turbine room, and the 50-ft deep basement. This compares with a 19.2-cu-ft-per-kw average for TVA's eight major steam plants.

All engineering and construction work on this new unit is under the direction of George K. Leonard, chief engineer; R. A. Monroe, chief design engineer; and H. T. Lofft, chief construction engineer. The mechanical design is under the supervision of the writer.



Westinghouse meters stop corrosion's bite

They also minimize the bite that meter maintenance and replacement costs take out of revenue. This new line of Westinghouse meters is the product of the most rigorous and exhaustive tests that the best meter research laboratory in the industry could devise. Complete compatibility of materials and finishes is the design secret which permits us to offer up to 500 per cent better corrosion resistance — even under the most extreme operating environment.

Westinghouse developments in the past two years have set the pace for the industry — and we're not stopping here. Watch Westinghouse meters for the Bonus Value Beyond Specifications.

YOU CAN BE SURE... IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

CHECK THESE BONUS VALUES FOR A BETTER METER BUY

Corrosion-Resistant Finish

(Epodur* protected frame –fully compatible finishes on all components)

Single-Metal System

(elimination of dissimilar metals in the register eliminates possibility of galvanic corrosion)

True Lightning Protection

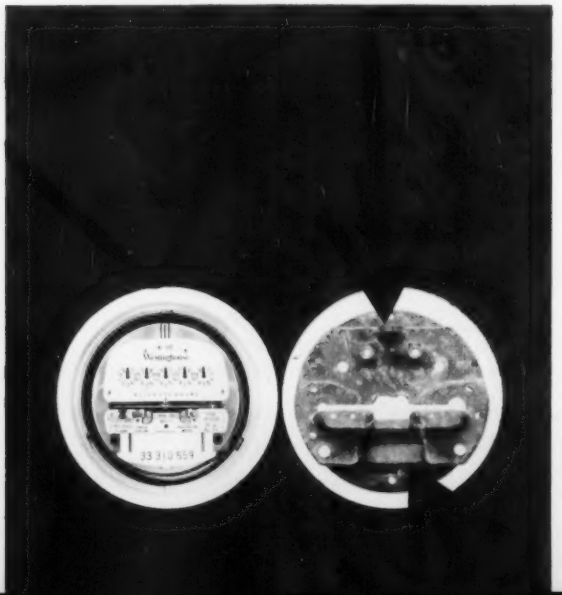
(exclusive Westinghouse De-ion® arrester gaps discharge surges harmlessly—outside the meter)

Lifetime Guarantee

(accurate registration, corrosion resistance, high insulation levels and thermal capacity—all offer a lifetime of bonus performance)

Watch the mail for this brochure, or get one from your Westinghouse sales engineer. It shows why Bonus Value is an important part of every Westinghouse meter.

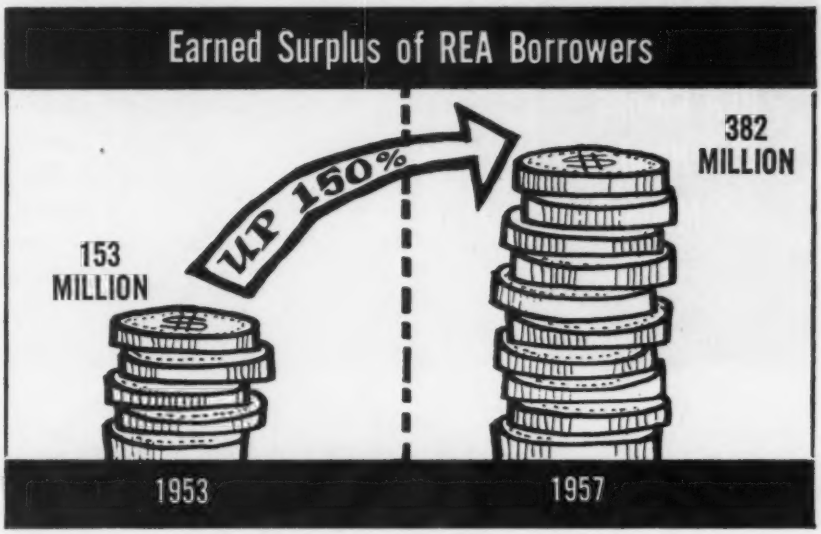
*Trade-Mark



YOU CAN BE SURE...IF IT'S

Westinghouse

JI-40503



Report on
REA Co-ops

Do Co-ops Still Need Subsidies?

Rural electrification has matured into a profitable business. Just how profitable it has become shows up in the most recent annual report published by the Rural Electrification Administration. In fact, this report (REA Bulletin 1-1, Annual Statistical Report—Rural Electrification Borrowers—1957) shows the REA co-ops now to be in such a state of financial health that their need for continued government aid is open to serious question.

The purpose for which the REA was created in 1935 was to bring electricity to rural areas which did not as yet have the benefits of central station service. Through REA, farmers in these remote areas could form cooperatives for the purpose of bringing power to their farms. In order to encourage these co-ops and set them on their feet financially, the government gave the co-ops certain advantages—among them, total exemption from the federal income tax and the right to borrow money needed to finance their projects from the U. S. Treasury at a low rate of interest.

The use of taxpayers' money to subsidize the REA co-ops was justified in the early days by need. The co-ops required government assistance if they were to make a start at accomplishing their mission—a mission described by Senator George W. Norris, co-author of the REA bill, as ". . . a simple matter of equity, justice, and progress." Norris also told the Senate: "It is not the idea that any of these organizations will make a dollar."

Today, however, the REA co-ops' financial position is somewhat different. According to the statistical report, they are accumulating surplus at a rapid rate: In 1953 their earned surplus amounted to $153,247,000. By 1957 it stood at $382,099,000—an increase of no less than 150% in four years. During the same period, the co-ops' net plant increased by 22½%.

The co-ops' statistics are for the 968 active REA borrowers who had energized electric systems in operation on Dec. 31, 1957. As of that date, REA had a total of 989 active borrowers. Only 88 former borrowers had repaid their loans, and two had had their loans foreclosed. Of the 989 active borrowers at the end

Do the REA Co-ops Still Need 2% Money?

Adjusted REA Balance Sheet
(for rate-making purposes)

Assets		Liabilities	
Net Plant	$2,386,445,000	Bonds	$2,456,254,000
Cash Working Capital	45,800,000	Contributions in Aid of Construction	18,915,000
Materials & Supplies	40,000,000	Membership Fees & Other Capital	35,908,000
Excess Cash & Cash Items to be used for investment	420,931,000	Earned Surplus	382,099,000
	$2,893,176,000		$2,893,176,000

NOTE: Adjustment explained in text below.

of 1957, co-ops totaled 928, or 93.8%; public power districts and other public bodies, 57, or 5.8%; and power companies, four, or 0.4%.

The "REA Balance Sheet" above has been set up from reported data as it would be set up for "rate making purposes" by a regulatory commission in dealing with a private utility. On the asset side, Net Plant is as reported. Cash Working Capital and Materials & Supplies have been computed as they are customarily computed by a utility company in a rate case. Cash Working Capital is equal to 45 days of expenses, a standard formula. The $40 million allowed for Materials & Supplies is a judgment figure based on the comparable standard for Class A&B private utilities not engaged primarily in generation. The remaining asset, Excess Cash & Cash Items for Investment, is a balancing figure.

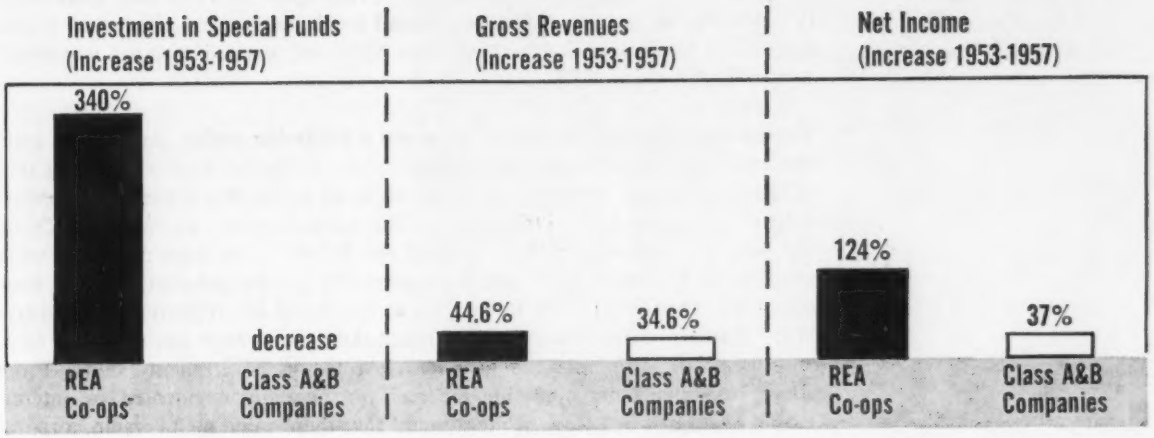
On the liability side, Bonds, Contributions in Aid of Construction, and Membership Fees & Other Capital are as reported. The accounts labeled by REA as "patronage capital credits," "operating margin," and "non-operating margin," have been lumped together and called Earned Surplus, which they are.

The most interesting fact that appears from this analysis is that the accounts for Bonds and Contributions in Aid of Construction add up to a figure approximately equal to the computed "rate base" of REA borrowers, and that the remaining liabilities (Membership Fees, etc. plus Earned Surplus) have an almost identical offset on the asset side of the balance sheet in the $421 million of Excess Cash and Cash Items to be Used for Investment.

The inference to be drawn from this, in plain language, is that the plant has been built entirely out of loans, and that surplus has been accumulated for the purpose of investing 2% money from the taxpayer at 4% or higher rates. Unquestionably the money is there, and it is accumulating at a rapid rate. Consider these facts from the statistical report:

- **Total retained earnings of REA borrowers** at the end of 1957 came to $85.50 per customer. This sum was accumulated over an average lifetime of REA borrowers of only about eleven years.
- **The co-ops' average annual accretions to surplus** amounted to $15.45 per customer in 1957. In 1953 this figure was $7.53 per customer. The rate of gain for the period was 102%.
- **In 1957, the co-ops set aside 13.1% of operating revenues as surplus.**

Another indication of the affluence in which the co-ops find themselves is net current asset position. Using gross plant as a measure of the size of operations,

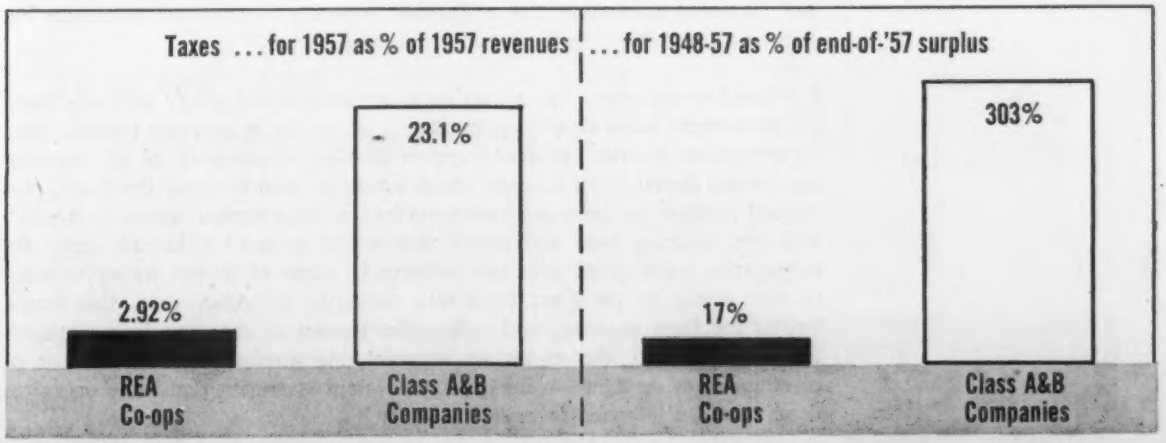


the net current position of REA borrowers in 1953 amounted to 10.9%. By 1957, the figure had dropped to 10.1%. (In contrast, the comparable figure for Class A&B private utilities was 0.52% in 1953; and in 1957 it rounded out to zero.)

The revenue-net income relationships tell the same tale. In the period from 1953 to 1957, the increase in revenues of REA borrowers amounted to 44.6% and that of the Class A&B companies amounted to 34.6%. Net income during the period rose 37% for Class A&B companies, 124% for co-ops.

But the co-ops' most spectacular growth has come in the "investments and special funds" account. This account came to a fairly substantial $43.7 million in 1953. By 1957, however, it had swelled to $192 million—an increase of 340%—and amounted to 6.27% of gross plant. By comparison, the total investment and fund account of the investor-owned utility industry amounts to 2.45%, of which 2% is investment in associated companies. It has declined since 1953, when it stood at 3.18% in total, of which 2.52% was investment in associated companies.

Part of this prosperity stems from the fact that, being cooperative enterprises, they enjoy preferences not available to private business. In the ten years from 1948 to 1957 (which is about the average age of the REA borrowers) these systems have accumulated a surplus of $418,000,000 while paying minor amounts, primarily for local taxes, of about $72,182,000, Class A&B com-



panies over their average lifetime (at least twice that of the REA co-ops) have accumulated $3,473,000,000 in surplus. From 1948 to 1957 they paid $14,000,000,000 in taxes to federal state, and local governments. In other words, the private utilities' outlay for taxes was 303% of retained earnings, compared to the REA co-ops' 17%.

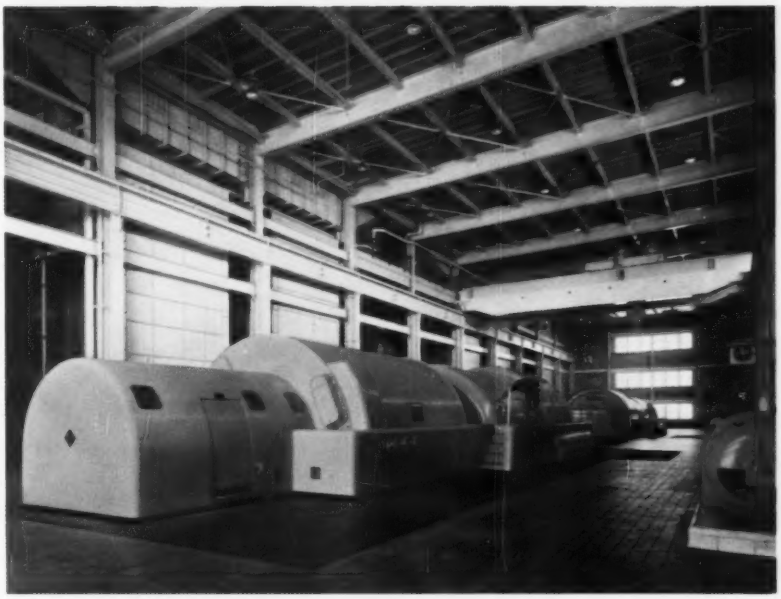
Tax exemption plus 2% money can make a profitable parlay, and there's good evidence that some co-ops are playing it. In 1956 the Public Service Commission of Indiana summed it up with reference to the Rural Electric Membership Corporations in its jurisdiction: "The annual reports of the REMC's on file with the commission show that all the REMC's are now operating on a remarkably profitable basis and have generally greatly reduced, and in some cases already fully paid off, their debts to the Rural Electrification Administration. Further, these membership corporations now have accumulated large surpluses which are in some instances invested in government bonds. From these investments net operating incomes are annually augmented by interest earnings at rates in excess of the amount that these same membership corporations pay to the Federal government as borrowers. Some if not all of the net operating and investment profits of the membership corporations are occasioned by the fact that unlike other utilities these cooperatives do not pay any federal income taxes upon such profits."

NRECA General Manager Clyde T. Ellis brought this out recently in an address to members of the National Rural Electric Cooperatives Association, as he called for more efficient application of the device. His address, entitled "Forward Together . . . in Rural Electrification" and delivered Feb. 9, 1959 before the 17th annual meeting of NRECA members, included a plea for cooperatives to invest their reserve funds more wisely than they had in the past. Said Ellis: "Most (rural electric) systems now invest a large part of their reserve funds in Government securities which do not yield maximum returns. Funds invested by a single system in the higher-yield, long-term governments may be recovered only at some loss if the bonds have to be cashed before maturity." Ellis proposed five alternative "plans" under which cooperatives might obtain better yields on their capital by pooling it for investment in "blue chip" corporate bonds as well as governments. In each plan, NRECA would act as trustee or agent.

NRECA published an excellent appraisal of the entire situation in its "Handbook on the Investment of Reserve Funds for Managers and Directors of Rural Electric Systems" (Revised Edition 1957): "It cannot be stressed too strongly that the accumulation of reserve funds in excess of those necessary to carry out the purposes outlined in the initial section of this handbook is contrary to the philosophy and the best interests of the rural electrification program. It lays the system and the program open to attack as utilizing loans from the federal government for purposes other than those intended by the Rural Electrification Act. It serves to weaken the confidence, not only of consumer members but of the nation at large, in the systems and the program."

It is hard to see why a co-op, acting as an unregulated utility and subsidized by government loans should accumulate these profits in order to transfer them to investment reserve. It would appear that—after payment of all expenses and annual depreciation accruals which would be used to repay the loans, plus a small cushion for operating contingencies—nothing further would be needed; and that anything over and above that would be used either to repay the cooperating participants who have substantial sums of money owing to them or else would be ploughed back into property. In either case, this would bolster the farm economy and lighten the burden of the American taxpayer. Instead, it appears, the co-ops are accumulating surpluses for the purpose of earning money on them—a far cry from Norris' statement that these organizations were not intended to make "a dollar."

ROCK RIVER GENERATING STATION
WISCONSIN POWER AND LIGHT COMPANY
150,000 kw—2 Units
1450 psig, 1000 F, Reheat 1000 F



A view of the turbine room at Rock River

Power in Wisconsin...

The Wisconsin Power and Light Company serves the southern and central part of the dairy state with a series of stations extending from the Mississippi River to Lake Michigan. Since 1930, Sargent & Lundy has served as consulting engineers for 420,000 kw of capacity for this company's progressive program. The latest plant in the system is Nelson E. Dewey Station, located at Cassville on the Mississippi River, where a 100,000 kw unit is scheduled for operation in October 1959.

FULL COLOR BROCHURE outlining the scope of Sargent & Lundy services will be sent on request.

SARGENT & LUNDY
ENGINEERS

140 SOUTH DEARBORN STREET, CHICAGO 3, ILLINOIS

New ORANGEBURG® CA* CONDUIT *with Flush Coupling Attached!*

With no separate couplings to handle or attach on the job, Orangeburg CA lays faster, costs less to install. Each long, light length has a *flush* coupling attached at one end and a standard 2° male taper at the other end, making installation a simple, one-step operation. And, since the coupling *is* attached, there are no coupling cartons to warehouse or carry to the job.

What's more, with the coupling *flush* to the conduit's outside wall, new CA is easy to stack, store and handle. The flush coupling also eliminates "staggered" joints in the trench. And that means real savings in cutting and tooling time.

Like the hundreds of millions of feet of Orangeburg fibre conduit in use since 1893, new CA has self-sealing joints and impermeable walls. Its smooth, 100% fibre raceway adds years to cable life.

New Orangeburg CA is available in 2", 3", 4", 4½" and 5" sizes. Orangeburg Standard and Nocrete Conduit, with separate sleeve couplings, are available as always. Write Dept. EW-59 for Catalog 52.

ORANGEBURG MANUFACTURING CO.
Orangeburg, New York • Newark, California
A Division of The Flintkote Company, Manufacturers of America's Broadest Line of Building Products

Orangeburg Fibre Conduit is distributed by Graybar Electric Co. and General Electric Supply Co. with branches and stocks in principal cities.

Hyer Elected President of Delaware P&L

Frank P. Hyer has been elected president and general manager of Delaware Power & Light Co. He succeeds H. H. Plank who was named chairman of the board. At the same time, Harold W. Clift was elected vice president in charge of gas and electric operations.

Formerly vice president in charge of engineering, operations and construction, Hyer joined Delaware P&L in 1947 as supervisor of operations. Prior to joining the utility, he was employed as operations and engineering consultant by General Public Utilities Corp, New York.

Clift joined Wilmington Gas Co in 1924 as a cadet engineer. He then advanced to assistant superintendent of the gas plant, assistant operating manager-gas, and manager of gas operations. In 1957, he was appointed operating manager with supervision of the gas and electric operations of the company.

Plank, who was elected president and general manager in 1956, joined the company as assistant to the general manager in 1943. He was later elected vice president of engineering and operations, and then vice president and general manager.

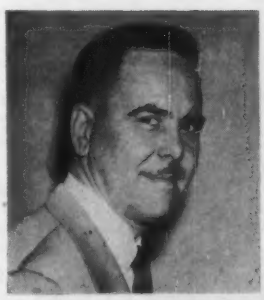
HYER PLANK CLIFT

Duke Power Names Jones, VP; Horn, General Counsel

JONES HORN

Duke Power Co has named D. W. Jones vice president and supervisor of branches and a director, and Carl Horn, Jr., general counsel.

Jones joined Duke Power at Burlington, N. C. in 1920 as a meter reader. He was appointed manager of its Leaksville office in 1931, of the Anderson district in 1940, and Winston-Salem in 1954. He was then named assistant supervisor of branches in the Charlotte general office in 1957. Horn joined Duke Power's legal department in 1954. Before that, he was a partner in a Charlotte law firm. He was elected to the Duke Power board earlier this year.



REDLHAMMER

Multi-Amp Names New VPs

Multi-Amp Corp has named Eduardo R. Redlhammer vice president, and Rue M. Shoop vice president and director of publicity. C. Harold Richardson was made assistant secretary and chief engineer.

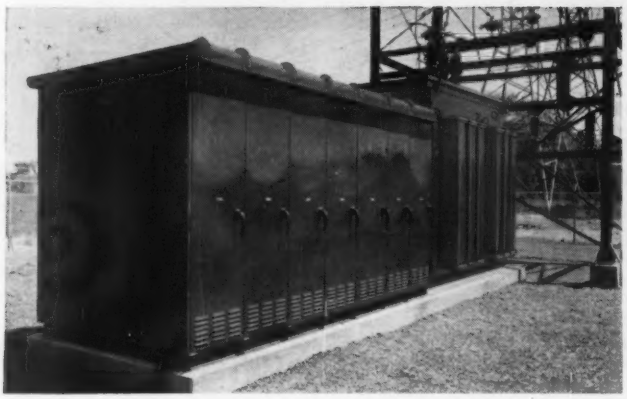
Redlhammer was formerly vice president of the Rectifier Division, Sel-Rex-Corp. Shoop is a former associate editor of Electrical World. Richardson was formerly in the engineering department of Anaconda Copper Co.

SHOOP

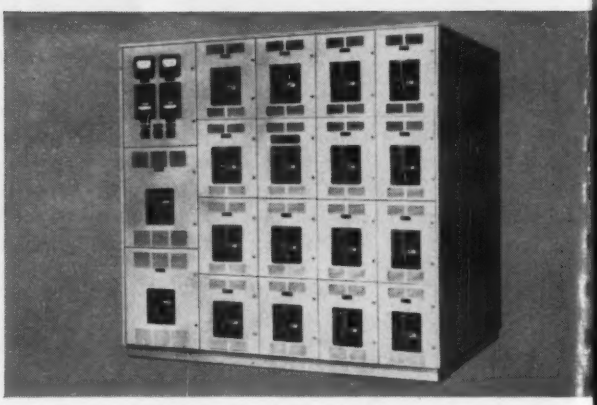
(*More News About People on page* 128)

I-T-E CIRCUIT BREAKER COMPANY

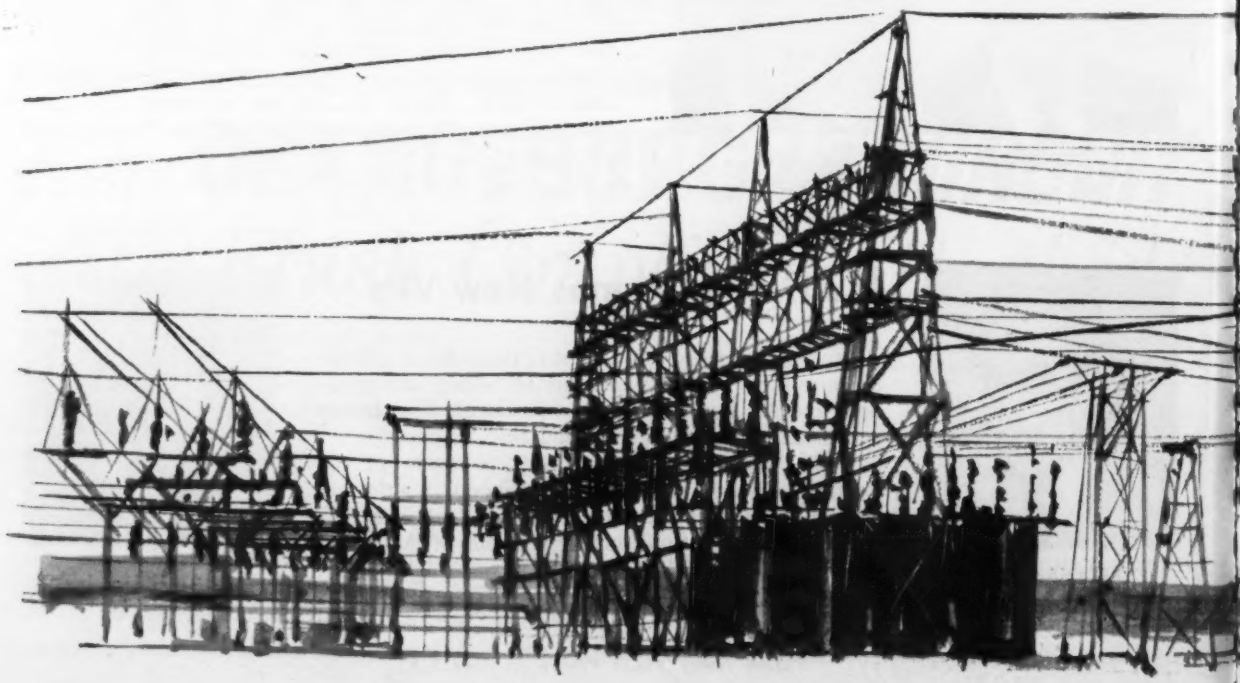
EFFICIENT



Custom designed at no extra cost. I-T-E primary unit substations are designed and built to meet your exact power, space and future expansion requirements. Transformer and switchgear sections are constructed in the same plant to assure smooth coordination of components, easier assembly, pretested performance and delivery to match your own construction schedule. Available in all standard kva ratings and secondary voltages to 13.8 kv.



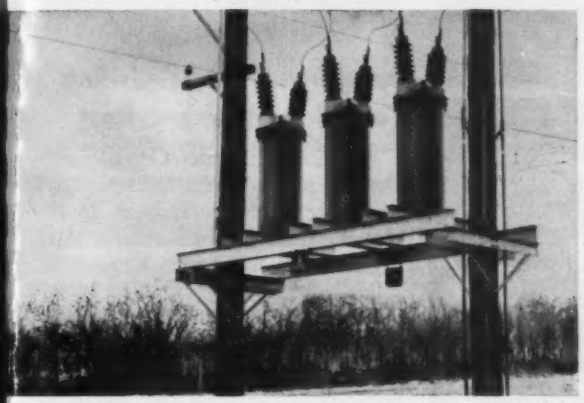
Easily adjusted for higher loads. Expanded calibration over-current trip device on I-T-E K-LINE low voltage switchgear provides maximum load flexibility and service continuity. Greater range saves costs of new trip devices. Manual quick-make closes contacts smoothly in only 5 cycles. Breaker can be moved from connected to test to disconnected position without opening door.



At I-T-E, substation structures are designed and fabricated in the same plant . . . under one responsibility. Once the single-line diagram has been prepared, engineering and manufacturing personnel closely coordinate every step of substation production—from preparation of layout drawings and application of blade switching equipment to the finished and carefully identified structural parts. You benefit from a more efficient design, more efficient use of materials, and virtually rework-free assembly at the installation site.

I-T-E's unified substation service has been meeting the needs of utilities for almost half a century. During this time it has delivered over 100 million pounds of steel substation components. And in 1947 I-T-E solved the problem of excessive maintenance due to corrosive atmospheres by producing the first all-aluminum substation.

The efficient planning and original thinking which are embodied in I-T-E substations are typical of the extra care—extra quality—found in all I-T-E products. Utility men know this from day-to-day experience with I-T-E equipment. And comparing prices shows that I-T-E quality costs no more.



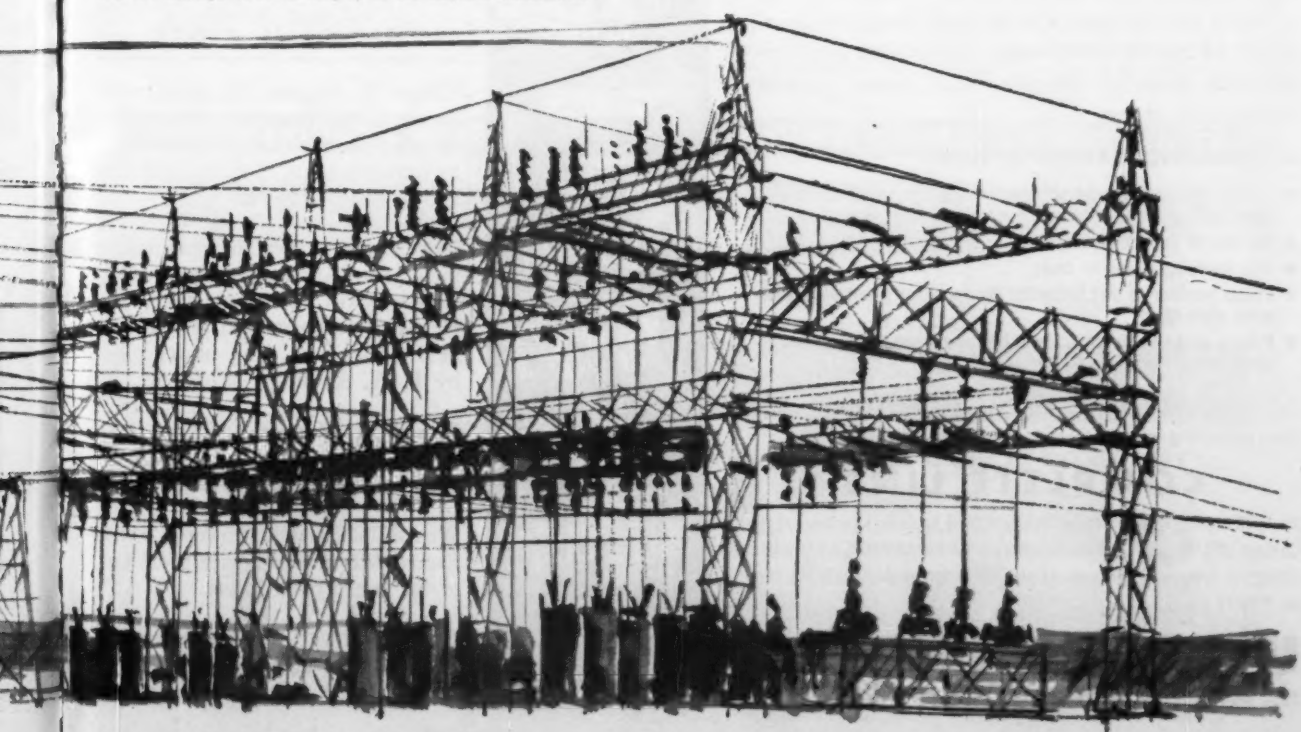
Fastest transient fault protection. I-T-E automatic circuit reclosers improve continuity of service . . . reduce lost revenue from outages. Faults are interrupted within 1½ cycles. Inverse time characteristics coordinate with fuses and protective relays to isolate persistent faults. No auxiliary power supply or control relaying is required. For 2.4 through 46 kv service, up to 400 amperes continuous.

I-T-E Circuit Breaker Company U-2
1900 Hamilton St., Philadelphia 30, Pa.

- ☐ Outdoor substation structures
- ☐ Primary unit substations
- ☐ K-Line LV switchgear (600 v)
- ☐ Automatic circuit reclosers
- ☐ Outdoor air switches
- ☐ Load interrupter switches
- ☐ Distribution cutouts
- ☐ Metal-clad switchgear (4.16 and 13.8 kv)
- ☐ Other_____

Name_____ Title_____
Company_____
Street_____
City_____ Zone_____ State_____

SEND COUPON Get full details on specific I-T-E equipment. And remember I-T-E engineering assistance is always at your disposal.



FEATURING A COMPLETE LINE
OF
SERVICE AND MAINTENANCE BODIES

The SERIES S-X SERVICE BODY features both front and rear VERTICAL door arrangement to utilize every inch of Body space.

The design of the SERIES S-X Compartment layout purposely encourages the storage of heavy material ahead of rear axle and lighter equipment in the rear. Rear vertical compartments are supplied with hooks to provide hanging of ropes, belts, and climbers. Horizontal and front vertical compartments contain material shelves, parts bins, and adjustable trays for storage of heavier tools and supplies on top of and ahead of rear axle. SERIES S-X SERVICE BODY provides three or more large compartments completely eliminating small, useless catch-all compartments or deep wells.

OUTSTANDING FEATURES INCLUDE:

- **Double mouldings around all door openings providing doors with triple sealing action keeping compartments water tight.**
- **Rub Rail to protect sides of body.**
- **Drip mouldings above all doors.**
- **Chains supplied so that horizontal door provides a horizontal work table when open.**
- **Precise workmanship and careful finishing result in equipment on which you are proud to display your name.**

Tell us your problems. Utility Body's Custom Design Service solves them by building to your requirements without additional cost.

COMPLETE LINE

There IS a UTILITY BODY to fulfill YOUR OWN Specific Requirements! Contact UTILITY BODY COMPANY for data on the SERIES S-X SERVICE BODIES or telephone your nearest distributor for complete information on UTILITY BODIES.

UTILITY BODY CO.

1530 WOOD STREET • OAKLAND 7, CALIFORNIA • TWINOAKS 3-8980

More News About People

(*Continued from page* 125)

Sangamo Names Griffith To Sales Manager Post

Sangamo Electric Co has appointed Hugh W. Griffith, Jr. sales manager, power equipment, to direct the efforts of the outside sales organization for power equipment.

He joined Sangamo after graduating from Alabama Polytechnic Institute in 1948. Since that time, he has been home office district manager and product sales manager.

PERSONAL BRIEFS

Claude E. Higgins has been transferred to the Hampton, Va., office of Virginia Electric & Power Co as superintendent of the service distribution department.

Clarence E. Archer has been named manager of Appalachian Power Co's Clinch River Plant at Carbo, Va. He has been succeeded as manager of the Glen Lyn, Va., power plant by **T. W. Abolin.**

Robert M. Kopper has been promoted to executive assistant of Indiana & Michigan Electric Co.

Wisconsin Electric Power Co has named **Alfred Gruhl,** vice president, to the board of directors.

Georgia Power Co has appointed **Hoyt A. Wiggins** superintendent of the Macon division. He succeeds

ANSONIA®

Ankoseal

Quality

POWER AND CONTROL CABLES

In The Finest Modern Plastics Insulations and Jackets

From the largest plant devoted entirely to the production of plastic cables come:

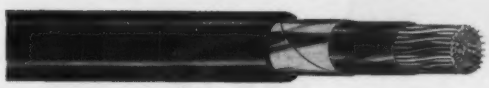
0-1000V CONTROL CABLE

Stranded conductors are flexible, insulated with polyethylene. Nylon jacket over insulation provides extra protection. Mylar tape over cabled conductors, polyvinyl chloride jacket.

0-1000V STATION CONTROL CABLE

Polyethylene insulated conductors, S. I. C. rating (2.39) and power factor rating (.0003) remain constant at high frequency and under wet conditions. Mylar tape over cabled conductors, polyvinyl chloride jacket overall.

SUPERVISORY CONTROL CABLE



Polyethylene or polyvinyl chloride insulation. Polyethylene or polyvinyl chloride jacket. With or without shielding. Color coded to I. P. C. A. specifications or as desired. Alpeth constructions to REA #22 and #23 specifications and composite types with twisted pairs available.

STREET LIGHTING CABLE

Direct burial, or overhead thermoplastic insulated and jacketed cables. Highly resistant to earth, acids and alkalies, moisture, sunlight and weather. Insulation either polyethylene or polyvinyl chloride. Shielded types available.

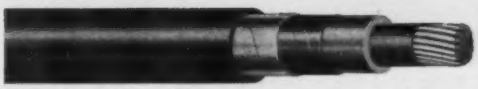
POLE AND BRACKET CABLE

Designed for street lamp base or overhead circuit to lighting fixture. Polyvinyl chloride installation polyethylene jacket. Low voltage operation between conductors — high voltage from conductors to ground.

CATHODIC PROTECTION CABLE

Insulated with polyethylene jacketed with polyvinyl chloride or special polyethylene. Highly resistant to most acids, alkalies and chemicals common in corrosive soil areas.

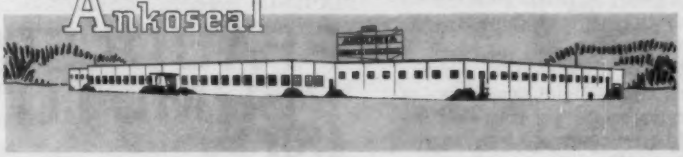
POWER CABLE 0-5000 VOLTS



Polyethylene insulated. Semi conducting tape over and under insulation. Metallic shielding tape and polyvinyl chloride jacket.

Ask for Ansonia Ankoseal Brochures on Supervisory and Station Control Cables — Street Lighting Cables.

THE ANSONIA WIRE & CABLE COMPANY



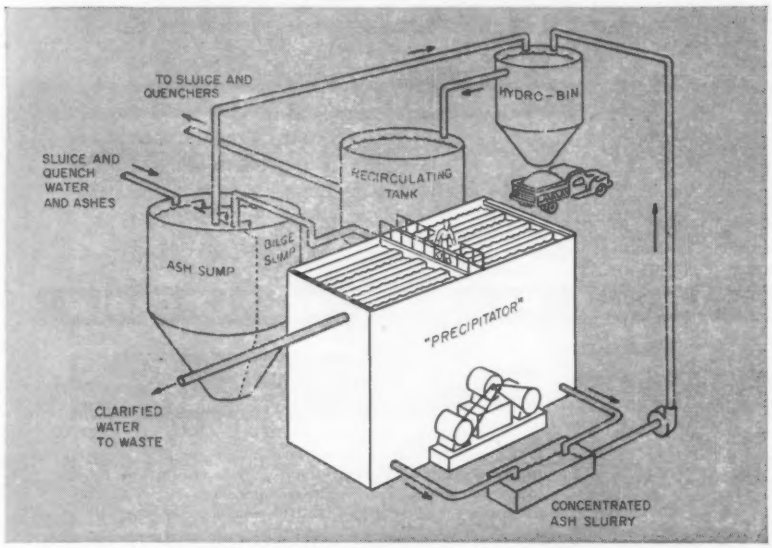
111 MARTIN STREET, ASHTON 12, RHODE ISLAND

"Leadership In Plastic Cables Through Quality and Service"

194-9

FLUIDICS

is a Pfaudler Permutit program providing
the know-how
the equipment
and the experience
for solving problems involving fluids



FLUIDICS AT WORK

Precipitator separates 15 to 25 tons of ashes per day for U.S. Rubber Co.

. . . makes ash-handling system flexible, dependable.

Ash problems at U. S. Rubber's Detroit plant are typical. The powerhouse has widely varying loads . . . requiring a flexible ash-handling system. The system must also be dependable, because all clarified effluent water goes into the Detroit River and this water must not contain suspended solids that could obstruct the river channel.

Tests were run at U. S. Rubber's plant using a pilot-scale Permutit Precipitator. As a result of these tests, a 300 gpm horizontal unit was installed. (See simplified flow chart.)

U. S. Rubber's Permutit Precipitator goes a long way to make their system successful. In use over 2 years, the Precipitator handles varying loads of 15 to 25 tons of suspended ash per day . . . at low cost without coagulants or other chemicals . . . yet it always delivers effluent water as clean as the river water itself.

on experience with all basic types of solids separation processes—coagulation, settling, flotation, centrifuging, evaporation and ion exchange. Write to our Permutit Division, Industrial Waste Treatment Dept. EW-59 50 West 44th St., New York 36, N.Y.

FLUIDICS covers such varied phases of fluid handling and control as:

water treatment	metering
waste treatment	valving
corrosioneering	flow rate control
fluid analysis	piping
agitation	storing
blending	heat transfer

Whenever you have a fluid-handling problem put the Pfaudler Permutit FLUIDICS program to work.

PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS . . . the science of fluid processes

John E. Wiatt who has been appointed to the newly created post of division manager.

Four appointments have been made by Shawinigan Water & Power Co. **A. C. Abbott,** formerly vice president, distribution, and **W. R. Way,** formerly vice president and chief engineer, have been appointed vice presidents with broader responsibilities in company affairs. **Jules Bouchard** has been named assistant vice president, commercial and distribution department, and **J. A. Smith** becomes assistant vice president, production and transmission.

Scott Brame has been elected assistant treasurer and **Clint Miller,** assistant secretary, of Central Louisiana Electric Co.

Promotions of four residential sales department personnel have been made by Connecticut Light & Power Co. **Elmer J. Major** has been named to the newly created post of division residential sales manager for the central division; **Robert S. D'Vileskis,** district residential sales manager at Thompsonville; **John R. McDonnell,** district residential sales supervisor at Bristol; and **Joseph R. Cronin,** district residential sales supervisor at Meriden.

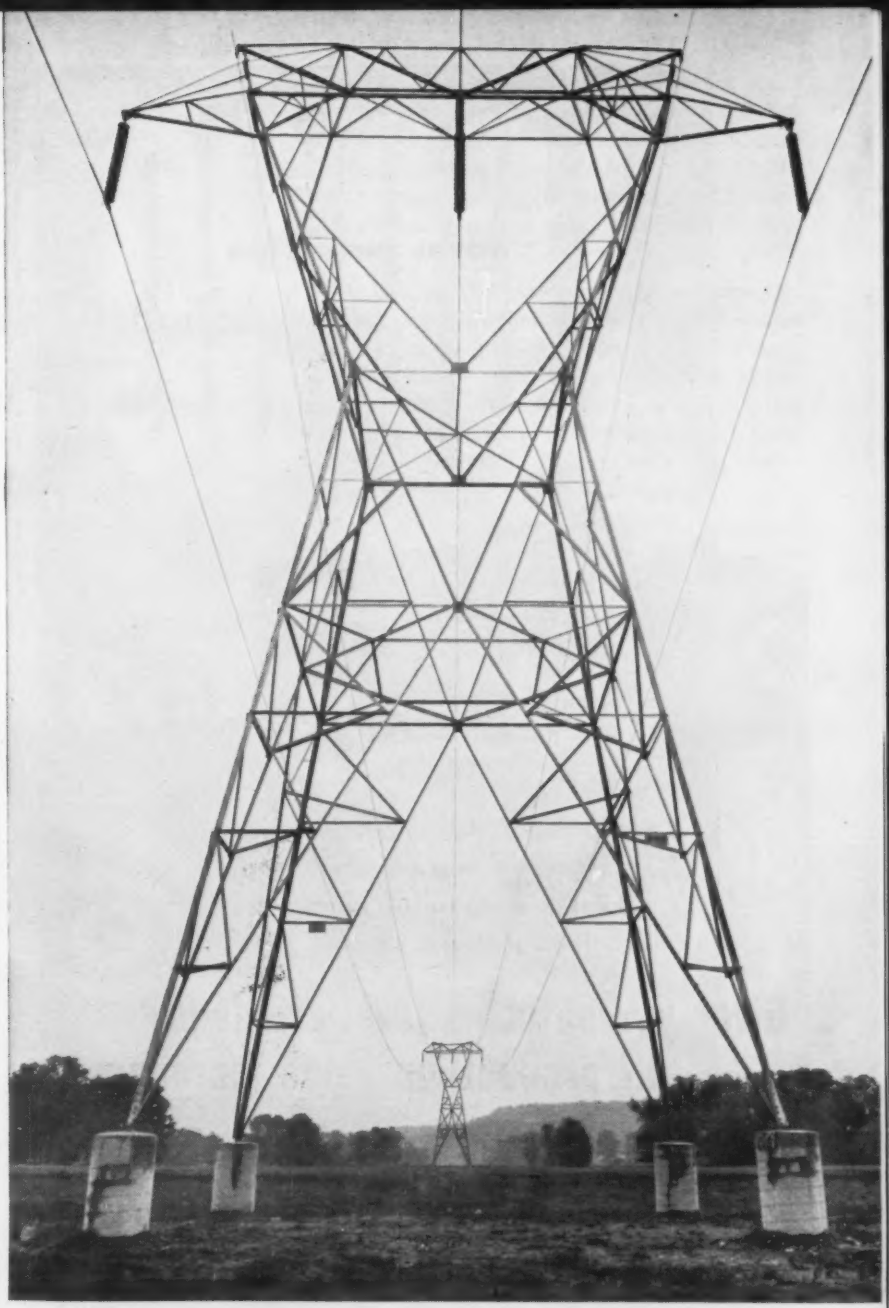
W. E. Bann has retired from the board of directors of Southwestern Electric Power Co.

OBITUARY

Carl M. Gilt, 67, retired assistant purchasing agent for Consolidated Edison of N. Y. . . . **Robert M. Raney,** 57, supervisor for Houston Lighting & Power Co . . . **John J. McKenna,** 68, retired Louisville Gas & Electric Co treasurer and vice president.

Otis Kirlin, 94, founder of The Kirlin Co, and builder of the first electric light plant at Watertown, S. D. . . . **George Innes,** manager, high tension hardware department, Brewer Titchner Corp . . . **William C. Dorn,** 57, district sales manager of Maloney Electric Co.

To withstand severe flooding in the Brandywine Creek area, over three miles of towers were designed with special foundations.



Philadelphia Electric uses 110 Blaw-Knox Towers to bring more power to Delaware County

From Bradford to Chichester—that's the route of Philadelphia Electric's new nineteen mile line. Carrying 220,000 volts, the new line will bring increased power to the highly industrialized lower Delaware County area.

Working as a team, Philadelphia Electric and Blaw-Knox engineers designed new light-weight towers to support three 795,000 CM ACSR conductors and two 134,600 CM ACSR groundwires.

Combining specific tower requirements with solid concepts of good tower design has been a Blaw-Knox specialty for over 40 years. Backed by this extensive experience, these skillfully engineered towers are noted for outstanding structural design, simple field erection and easy modification.

Folder 2509 details this know-how in tower engineering and fabrication. Send for your copy and tell us your needs. We'll gladly give you our recommendations and a quotation.

Transmission Towers—Steel Transmission towers, custom-built for each installation . . . multi-circuit and other special structures . . . and antenna towers, guyed and self-supporting types for AM • FM • microwave • communications • radar • parabolic antennas.

BLAW-KNOX

BLAW-KNOX COMPANY
Equipment Division
Pittsburgh 38, Pennsylvania

BK-4403

LGP-30

ROYAL PRECISION

Electronic digital computer permits load-flow calculations on networks of up to 100 busses and 270 lines at lowest cost

Gives you optimum level efficiency in production, sales, purchase!

The lowest-priced complete computer you can buy, the versatile LGP-30 saves you time and money by 1) economically solving your load-flow problems; 2) forecasting optimum turbine-generator and boiler usage under varying conditions of system demand; 3) optimizing purchase and sales of power.

Now at work serving numerous electrical utilities, the compact, mobile LGP-30 operates from any convenient wall outlet . . . requires no expensive air-conditioning or installation. It gives you twice the capacity of any computer in its class, yet is by far the easiest to program in basic machine language.

Internal components of the LGP-30 have been greatly reduced to insure highest reliability. Operation has been remarkably simplified. Your personnel are quickly trained by Royal McBee without charge. Sub-routines and programs are available – as well as membership in an active users organization. Sales and service facilities are maintained coast-to-coast. For further information and specifications, write Royal McBee Corporation, Data Processing Division, Port Chester, N.Y. In Canada: The McBee Company, Ltd., 179 Bartley Drive, Toronto 16.

ROYAL McBEE • *data processing division*

Ormet Distribution . . .

(*Continued from page* 69)

The final run from the pole or pipe rack was made in underground conduit encased in a concrete envelope. This part of the run was kept to a minimum. An underground duct system for this distribution was considered, but discarded since it was desirable to make the system as reliable as possible and contamination of the ground from chemicals used in the process could be expected. With this overhead system all cables except the short underground runs are exposed and open for visual inspection. Any faults can be readily located and repairs economically made. Where the cable trays are on common supports with piping, they are protected from mechanical injury by a continuous steel plate. This was necessary since repairs on the piping would be frequent and the pipe would be handled by crane.

No Cable Shielding Used

Two cable tray systems are installed. One system contains all of the cables from generator bus section No. 1 and the other from bus section No. 2. Where the cables leave the tray and run aerially, the No. 1 feeders are supported on one side of the poles and the No. 2 feeders on the opposite side. The round steel poles, which are also used to mount street lighting units, are anchored in concrete and spaced from 100 to 150 feet apart.

All of the conductors for this system are copper, single conductor, 5-kv, butyl rubber insulated, polyvinyl chloride jacketed cables rated for a maximum copper temperature of 85 C. Since two feeders, each capable of supplying the full distribution center load, are installed to each critical distribution center, the additional cost of the shielding could not be justified. A polyvinyl chloride jacket was selected because it is more resistant than the conventional neoprene jacket to corona, moisture, and the chemical contaminants that could be expected in the atmosphere.

Power system protection at the 4-kv switchgear is provided by two time-overcurrent phase relays and one residual ground relay for each

(*Continued on page* 134)

Why Kaiser neoprene-jacketed cable was used in Lincoln Tunnel signal system

The Lincoln Tunnel requires a myriad of signal lights to regulate traffic under all conditions. For this complex system of circuits the designers specified multi-conductor cable manufactured by the Bristol Works of Kaiser Aluminum and Chemical Corporation. The cable is jacketed with Du Pont neoprene.

The time-proven performance of neoprene led to its use in this installation. The designers wanted a flexible, easily installed cable with an abrasion-resisting jacket to protect the conductors against rough handling. And they wanted a jacket that would give long-term protection against deterioration by exhaust fumes. They got what they wanted with neoprene.

The results of countless installations prove you can be sure of lasting performance when you specify neoprene jacketing for wire and cable. For details, write to: E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Dept. EW-5, Wilmington 98, Delaware.

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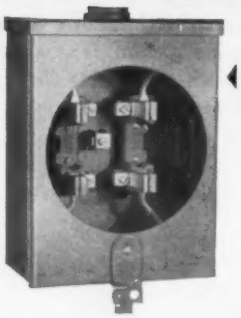
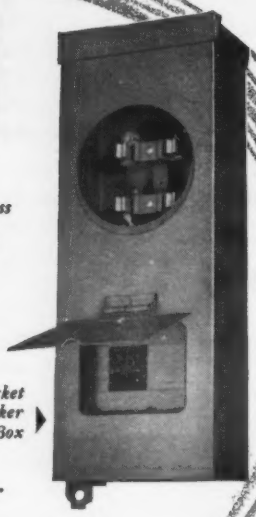


Ringless Meter Socket



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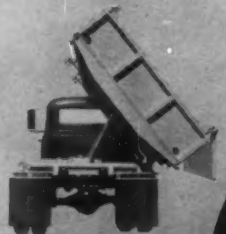

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Ormet Distribution

(*Continued from page* 132)

of the two incoming feeders. The outgoing feeders to the 4-kv motors and the 480-v power centers are served by combination fuse and contactor arrangements. The fuses provide the short circuit protection. Overload protection for the cables and motors is provided through thermal overload relays (49).

Test Rack in Each Center

Ground fault protection is provided through a relay which is energized from a donut type CT encompassing the conductors of each phase. The output of this current transformer reflects true zero sequence (ground fault) current. Since the maximum ground fault current is 2,000 amp, much smaller than the interrupting rating of the contactor, ground faults are cleared by dropping out the contactor. This eliminates single phasing.

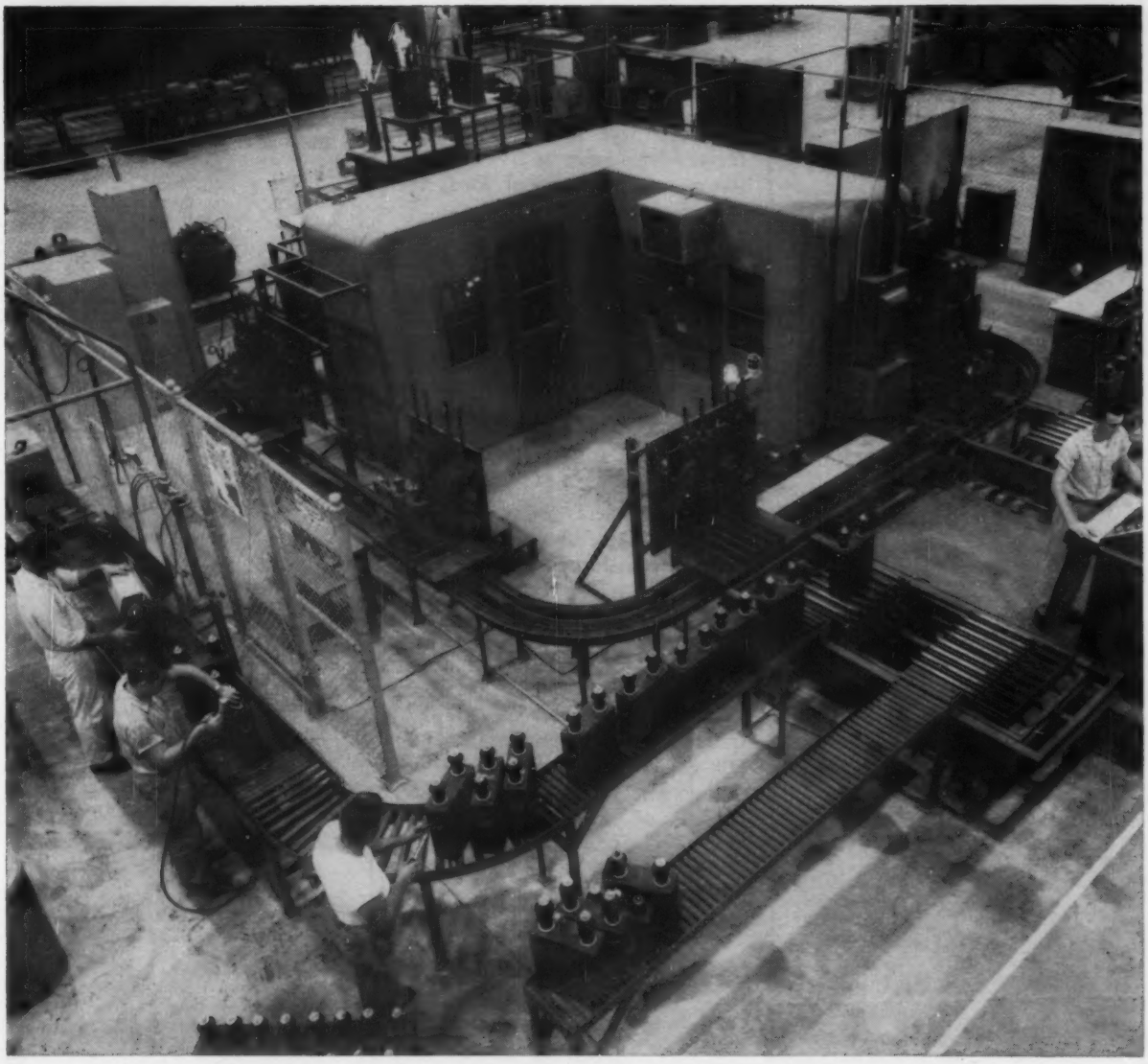
A circuit breaker test rack is standard equipment for each center. Most of the routine maintenance and repair that will be necessary can be accomplished without loss of any vital production equipment.

Coordination of protective relays of the 4-kv system is shown in Fig. 1. The phase overcurrent relays are represented by curves 1, 2 and 3. Curve 3 represents the incoming line relays at the 4-kv distribution switchgear; Curve 2, the feeder relays at the generating station control board; and curves 1A and 1 the generator phase overcurrent relays with zero voltage restraint and 115-v restraint respectively. Curve 4 represents the largest fuse in the fused contactors for the 4-kv motors.

Curve 5 represents the ground fault relay protecting the grounding resistor, curve 6 the feeder ground fault relays at the generating station. Curves 7 and 8 represent the incoming line relays and the feeder relays respectively that are situated at the 4-kv distribution switchgear.

All secondary 480-v substations consist of outdoor, oil immersed, self-cooled 3-phase transformers, throat connected to 480-v indoor metal clad switchgear. Each transformer is rated 1,000 kva, 4,160

(*Continued on page* 136)



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To give you the most in long capacitor life and dependability, Westinghouse has eliminated human error from quality control at the new Distribution Apparatus Plant at Bloomington, Indiana. An automated testing facility* administers a series of rigid tests to every capacitor produced on the line, climaxing a total of eight other quality control checks made during production.

A sequenced conveyor carries the capacitor through six test stations: capacitance, 60-cycle overpotential, d-c overpotential, 25-cycle overpotential, resistance, and finally a recheck of capacitance. At the end of the testing cycle, the unit is automatically sent to the shipping area, or rejected if faulty.

A punch card automatically programs the sequence of tests required for each type of capacitor.

Through this automated system, you are assured of the highest quality and reliability in your capacitor equipment.

For information on capacitors, call your Westinghouse representative or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60940

**This testing equipment, called OPCON, recently received the Industrial Science Achievement Award from the American Association for the Advancement of Science.*

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Phone CE 2-7234

CABLE SPINNING EQUIPMENT CO.

Topeka Kansas

Ormet Distribution . . .

(*Continued from page* 134)

delta primary and 480-277/480 v grounded wye secondary. Transformer impedance is 5½%. Substations serving critical loads are double-ended.

The transformer primaries are protected by the fused contactors in the 4-kv switchgear lineup. The secondary 480-v draw-out switchgear consists of 1,600-amp main and tie breakers and 600-amp feeder breakers. The main and tie circuit breakers have an interrupting capacity of 50,000 RMS symmetrical amp and the feeder breakers, 30,000 RMS symmetrical amp. Tripping of breakers during short circuits is selective and is coordinated with the transformer primary fuses.

All Motors Totally Enclosed

Motors ⅛ hp and larger are served at 440v, 3 phase; all smaller motors are supplied at 120 v. Lighting systems are served with centrally located 3-phase 480-120/208-v dry-type transformers. All wiring for secondary distribution consists of single conductor wire and cable in exposed rigid steel conduit.

All motors are totally enclosed squirrel cage, chemical type motors. Motors rated 100 hp or more are equipped with temperature switches which shut the motor down on excessive temperature. The 440-v motors are served and protected by factory fabricated motor control centers, in the distribution center buildings. Motor starters in the control centers are combination air circuit breaker and magnetic across-the-line type, with two hand-reset overload relays. Each motor starter control circuit is supplied through a 480/120-v control transformer, located in the starter compartment. One side of the 120-v circuit is fused and the other grounded. When the circuit breaker of a combination starter is open, all circuits in the starter are de-energized. All motors and utilization equipment are grounded through a grounding conductor run in the same conduit with the power leads. This provides a low ground impedance and minimizes the hazard of having ground fault currents flowing through the conduit system.

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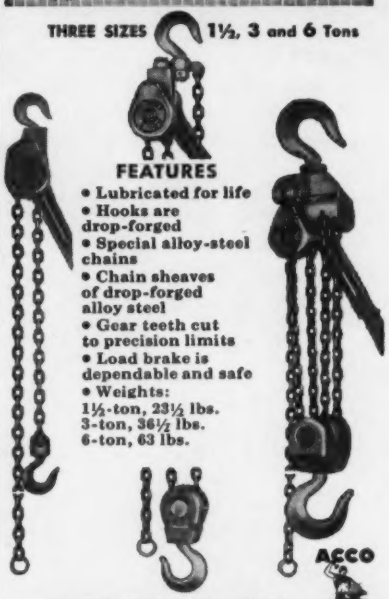

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Premium Put on Load Building

A Merchandise Sales plan which appraises the value of each appliance sale from the standpoint of electrical revenues, rather than the selling price of the appliance, has been put into effect by Georgia Power Co. Its purpose is "to encourage a wider use of electrical energy by residential customers," according to C. M. Wallace, vice president in charge of sales.

Individual quotas, reports and salesmen's compensation will be determined by these values in the future. Sales will be evaluated in "credit points" rather than in dollar volume of merchandise sold.

Georgia Power carries a full line of both major and small electrical appliances. An appliance value has been assigned to each, ranging from 20 for a clock to 3,450 for an electric water heater. These values equal the average annual kwhr consumption of each appliance.

The company's residential customers have been divided into three groups, and each has been assigned a customer factor of either 3,2 of 1, which approximates the cents-per-kwhr paid for energy. The company has 588,132 residential customers of which about 27% are in the "lowest use" group, using less than 100 kwhr per month; a "middle group" using from 101 to 200 kwhr a month (29%); and the "top group", comprising 44% of the total.

Credit Point System

The credit points for each sale are derived by multiplying the appliance value by the customer factor. Thus, the credit points are representative of the electrical revenues (in cents) which each appliance sale returns to the company.

Example: An electric clothes dryer used by a residential customer consumes an average of 800 kwhr per year. It, therefore, is assigned an appliance value of 800. When sold to the large consuming customer, with a customer factor of 1, the sale earns 800 credit points. When sold to the middle group, paying 2¢ per kwhr, the customer factor is 2 and the sale earns 1,600 credit points. When sold to the lowest user the sale is worth 2,400 points. These sales would return annual revenues of $8.00, 16.00 and 24.00 respectively.

Salesmen are compensated on a plan of base salary plus commission. The commission rate is ½¢ per credit point, or $4.00, 8.00 or 12.00 for the above example.

One of the most desirable features of the plan, according to the company, is the flexibility which will enable management to increase appliance values for campaign purposes from time to time.

Georgia Power has set a quota of 35,000,000 credit points for this year. The January quota was exceeded by 19%. After four months, the plan is producing revenue at a cost to revenue ratio of 1.24.

EEI Begins Local-Level Promotion for NELP

The first local-level promotion for Edison Electric Institute's National Electric Living Program helped 12 dealers in Marion, O., sell 236 major appliances in an 8-day period. The promotion, part of the All-Electric Kitchen Carnival, tied in with the national ad by EEI in the April 4 issue of Saturday Evening Post, and was cosponsored by Ohio Edison Co with the magazine.

In the eight days prior to the promotion, only 90 major appliances were sold.

A 50% increase in traffic appliances was also achieved during the promotion. The actual traffic count in the 12 dealers' stores was 31,000 people, compared to a normal eight-day period count of 4,758.

One of the dealers who was planning to go out of business changed his mind as a result of the promotion. Another dealer sold five ranges, equivalent to the number he sold over a nine-month period last year.

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Representative wanted for manufacturer of street lighting equipment, pole line specialties. Full particulars. RW-9821, Electrical World.

U. S. Government

DEPARTMENT OF THE INTERIOR, Bureau of Reclamation. Sealed bids (Specifications No. DC-5193) will be received at Denver Federal Center, until 2 p.m., Mountain Standard Time, June 16, 1959, for furnishing and installing one (1), 100,000-kva, 16,500-volt, vertical shaft, 60-cycle, 180-rpm, vertical-shaft, hydraulic-driven generator for Hoover Powerplant, Boulder Canyon Project, Arizona-California-Nevada. Completion time 720 calendar days. For particulars, address Bureau of Reclamation, P. O. Box 427, Boulder City, Nevada; or Building 53, Denver Federal Center, Denver 25, Colorado. Floyd E. Dominy, Commissioner.

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Readers Forum

Article Strains Imagination

To the Editor:

The timely articles appearing in Electrical World from various sections of the country on cost-saving methods being utilized in connection with rendering reliable electric service are very beneficial thought-provokers as the natural tendency is to review one's own studies in the light of reported experiences.

In reviewing these articles we occasionally note cost comparisons which strain the imagination when attempting to reconcile equitably. The $11.79 per kva saved with 34.5 kv distribution as reported on page 74 of the April 13, 1959 Electrical World strained beyond the yield point.

As we see the picture from the information given, the real comparison is: (a) traversing the distribution area with 138 kv transmission and direct step-down to 34.5 kv distribution at three points in Minidoka County versus (b) step-down from 138.kv transmission to 46 kv subtransmission outside the distribution area and extending both 46 kv subtransmission and 12.5 kv distribution, with four additional step-down stations, in Cassia County.

The cost figures, without question, establish the economics of direct step-down rather than the dual transformation and subtransmission arrangement. However, regarding the relative economics of 34.5 kv and 12.5 kv distribution, the figures presented show the opposite, using the following reasoning:

1. Cassia County could have been served on a comparable basis to Minidoka County by traversing the distribution area with 138 kv transmission and installing three 138/12.5 kv distribution substations.

2. Cost of transmission and distribution substations thus required in Cassia County would have been no more than for Minidoka County, judging from the map and the fact that 12.5 kv switching costs would be less than for 34.5 kv. This assumption actually favors the 34.5 kv distribution and would no doubt be sufficient to offset any additional distribution cost necessitated by three instead of four distribution substations.

3. Conclusions listed under 1 and 2 above leave the distribution (pole lines and transformers) to stand alone on their relative economics which amount to $38.90 per kva for 12.5 kv and $40.60 per kva for 35.5 kv or a $1.70 per kva premium for the 34.5 kv, which it may be worth.

The point is, if there are good and valid reasons for the higher distribution voltage such as are given in the article, why not use them? The figures given do not economically justify the higher voltage on the basis of equitable construction cost comparison.

Robert M. McCuistion
1042 Gardenia Drive
Houston 18, Texas

"Dreamer Club" Entry

To the Editor:

Here is my suggestion for the "Crackpot Division" of the Electrical Dreamers Club:

Criss-cross the nation with chains of battery-service stations for the electric car.

H. C. McDaniel
Technical Information
Westinghouse Electric Corp
Box 2278 Pittsburgh, 30, Pa.

Admission to the "Electrical Dreamer's Club" is gained by submitting one good idea for publication.

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43. A new electron tube that will go inside a thimble is being made to compete with the transistor.

44. Rustproof hub caps for automobiles are being made of fiberglass.

45. Bulbs can be installed in a new electric light fixture with only a quarter of a turn.

46. An inexpensive attachment for any radio sounds an audible warning if radioactive fall-out reaches a dangerous level.

47. A giant earth mover, driven by an electric motor in each of its eight wheels can scoop up a fifty-ton load in less than two minutes.

48. Ultrasonic energy, used in machining hard or brittle metals, can now be transmitted around corners.

49. A research camera with 1,200 lenses can take pictures at the rate of 42,000 per second.

50. A new diesel-electric locomotive can be switched to third-rail operation without stopping.

51. Electric automobiles are in production again. Range on a charge is eighty miles.

52. A miniature TV system made for use in a missile weighs only nine pounds and has a range of 1,000 miles.

53. Maximum spark at all engine speeds is claimed for a new transistorized ignition system for internal combustion engines.

54. The first telescope in space is in the plan stage. It would map the sky in ultraviolet light which is blocked by the earth's atmosphere and would be supported by an unmanned orbiting vehicle.

55. A proposed atom smasher would be two miles long and eight times more powerful than any now in existence.

56. Paraplegics may use a new typewriter in which photoelectric cells are substituted for keys. A lamp on the user's head actuates the cells.

57. A magnet is used instead of screws to hold a new fishing reel together. The magnet also provides the necessary drag.

58. Aluminum shingles are now being made in a variety of permanent baked enamel colors.

59. A new helicopter can carry six tons of cargo.

60. A system of harnessing helicopters in teams by the use of metal spreaders has been developed.

61. An electric drink mixer that can be used anywhere operates on flashlight batteries.

62. A dentist has invented a toothbrush powered by an electric motor.

63. The successor to the "Jeep" is a new 1,700-pound vehicle powered by an aluminum, air-cooled V-4 engine.

64. A New York Bank has installed a clock, powered by a radioisotope, that will run for 200 years without winding.

65. Interchangeable tips for pliers make one tool serve many purposes.

66. The Air Force has discovered that submerging a man in water doubles his resistance to acceleration.

67. A new Army rifle is replacing the Garand. It holds twenty cartridges which can be fired at the rate of twelve and one-half a second.

68. Plate glass floated on the surface of molten metal is said to have a better finish than that produced by grinding and polishing.

A NEW MINE—
UNDER 50′ OF WATER!

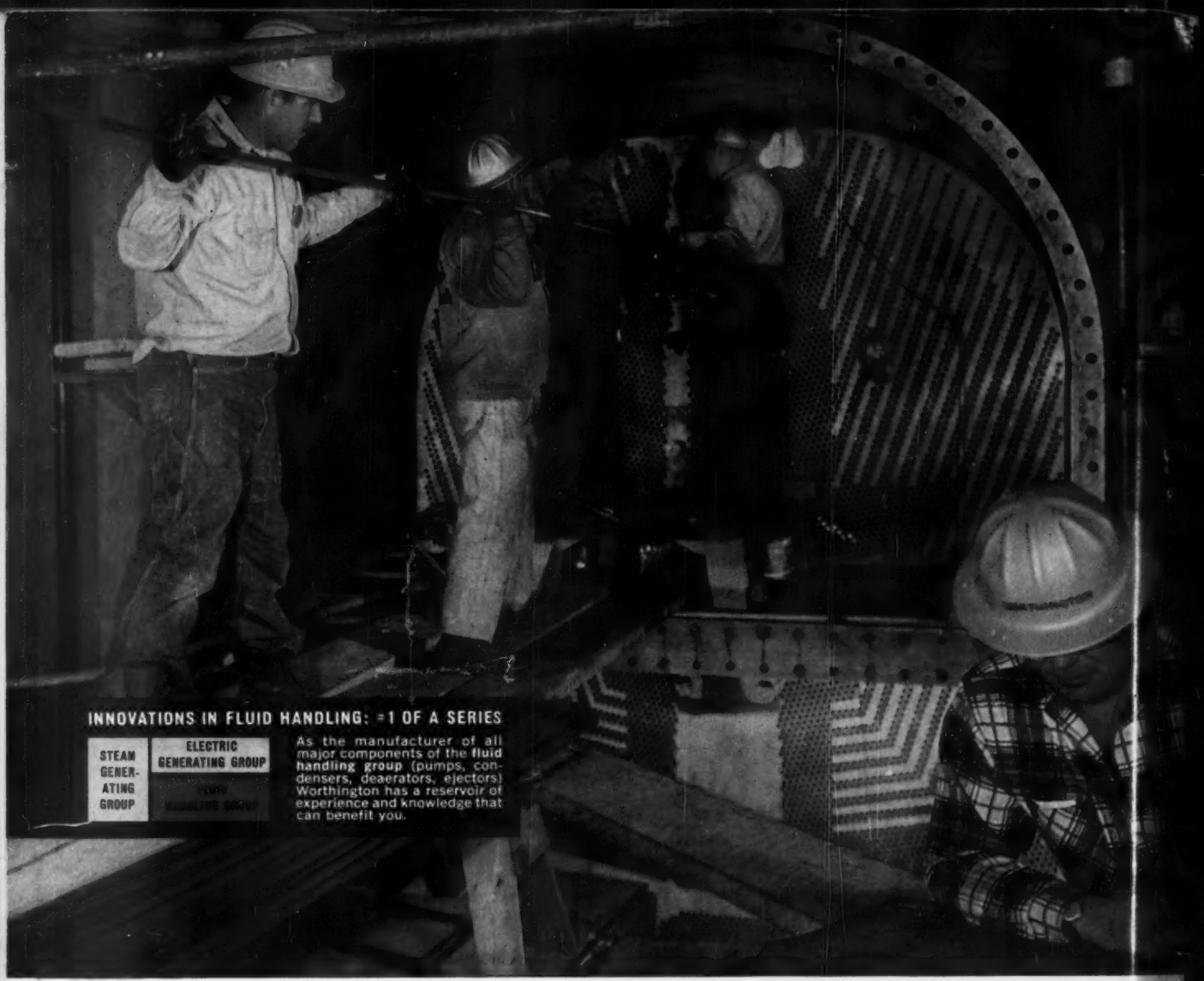
Seven miles off the coast of Louisiana, Freeport Sulphur Co. is completing the world's first offshore sulphur mining plant. This unique engineering project consists of a Y-shaped steel island nearly one mile long (the world's largest) erected over a major new sulphur deposit known as Grand Isle.

Supplying power to the drilling platforms and other machinery are Simplex ANHYDREX XX insulated Submarine Power Cables. With a background of forty years' service to the mining industry, Simplex is proud to have contributed to this pioneering project.

SIMPLEX WIRE & CABLE CO.
Cambridge, Massachusetts and
Newington, New Hampshire

Simplex

Highest quality cables for: Mining
Power & Lighting • Construction
Transportation • Communications
Signalling


INNOVATIONS IN FLUID HANDLING: #1 OF A SERIES
STEAM GENERATING GROUP
ELECTRIC GENERATING GROUP
As the manufacturer of all major components of the fluid handling group (pumps, condensers, deaerators, ejectors) Worthington has a reservoir of experience and knowledge that can benefit you.

NUCLEAR CONDENSER

Dresden unit is tailored to special needs of nuclear plants

Engineers of General Electric, Worthington and Bechtel Corporations worked together closely with Commonwealth Edison on new Dresden Station.

Four major problems faced Worthington in the design of a 120,000 sq. ft. condenser for the Dresden Nuclear Power Station being built by General Electric Co. for Commonwealth Edison Co. and the Nuclear Power Group, Inc. They were: (1) necessity of handling full output of dump steam, (2) quantities of free gases in the steam, (3) maintaining condensate purity, and (4) providing radioactive decay time for the condensate.

Worthington engineers, working in close cooperation with the customer, his design engineers and contractors, solved these problems. To handle dump steam, pressure breakdown devices were installed in the condenser itself and in a special "blister" on one side of the condenser. An extra large ejector was used to handle quantities of free gases. And to maintain condensate purity double tube sheets were used and special deaeration features were provided.

Radioactive decay time was provided by means of the special hotwell which is baffled to make the transit time of the condensate long enough to allow short-lived radioactive impurities to decay to lower levels.

This typical example shows you how Worthington applies its experience as a manufacturer of all major components of the fluid handling group in solving the problems of one particular element. To put this progressive "know how" to work on your power plant problems, conventional or nuclear, contact your nearest Worthington district office. Or write to Worthington Corporation, Section 45-8, Harrison, N. J. In Canada: Worthington (Canada) Ltd., Brantford, Ontario.

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